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SELECT DISSERTATIONS ON SEVERAL SUBJECTS OF MEDICAL SCIENCE.

BY

SIR GILBERT BLANE, BART. F.R.S S.
LOND. EDINB. AND GÖTTING.; MEMBER OF THE IMPERIAL
ACADEMY OF SCIENCES OF ST. PETERSBURGH; AND
PHYSICIAN TO THE KING.

NOW FIRST COLLECTED, WITH ALTERATIONS AND ADDITIONS;
TOGETHER WITH
SEVERAL NEW AND ORIGINAL ARTICLES.

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TO

THE KING.

SIRE,

I HAVE been induced to solicit the sanction of YOUR MAJESTY'S Name to this work, from reflecting, that the subjects of it have arisen either out of a course of public duty, in which it was my lot to witness, and to act an humble part, in some of the most splendid events of British History, or during a period in which I have had the honour of being engaged in the service of YOUR MAJESTY'S Person and Family. In the exercise of these and other duties of a profession, which has for its end the alleviation of human suffering, and the saving of human life, it has been my aim, to the utmost of my inadequate powers, to extend its utility, and uphold its dignity, by founding it on the deep and solid basis of genuine science and sound philosophy, as the most acceptable service I could render to a Monarch, who, as He is the Father of His People, so is He the object of their veneration and affection. And I count it one of the most happy incidents of my long life, that, in addition to all the ordinary motives to the discharge of my duty, I have felt my labours sweetened, and my exertions animated, by the further incentive of rendering myself, if possible, not unworthy of the distinguished confidence and encouragement of a Sovereign, who is the Patron of Literature and Science, as well as of all the useful and liberal Arts—of a Sovereign, also, by whose wisdom and vigour, seconded by the matchless energies of a free, a loyal, a virtuous and valiant nation, Europe has been rescued from subjugation and oppression, through a series of achievements, which in lustre and effect, surpass whatever has been recorded in the annals of the world.

I entreat YOUR MAJESTY to accept this tribute of the homage and attachment of

YOUR MAJESTY'S

Most faithful, most devoted, and
dutiful Subject and Servant,

GILBERT BLANE.

London, November 15, 1822.

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DISSERTATION I.

On the COMPARATIVE HEALTH *of the* BRITISH NAVY, *from the Year* 1779 *to the Year* 1814, *with Proposals for its farther Improvement.*

THE writer of this article proposes to lay before the Society* an account of the progress and causes of the improved state of health of the British navy, from the period at which France and Spain became parties in the war with the American Colonies, to the year of the general peace, which for a time closed the revolutionary war of France; and to submit certain proposals for the further improvement of the health of this valuable class of men.

Besides the means of information which occurred to him while he was physician to the fleet in the West-Indies and North America, during the four last years of the American war, and while he was commissioner of sick and wounded seamen, from the year 1795 to the year 1802, he has been furnished, by virtue of an application made in the name of the Society, with materials from the public offices of the navy, all of which most liberally supplied such extracts from their records as were necessary for his purpose.

Some of the most important results of these researches are thrown into the form of Tables, which are inserted at the end of this paper.

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* The greater part of this Dissertation appeared as an article in the sixth volume of the Transactions of the Medico-Chirurgical Society.

It appears from the inspection of the two first of these, that there has been a gradual and great diminution of sickness and mortality in the course of the above-mentioned series of years; as is proved by the numbers received into the hospitals, which must be admitted as a satisfactory criterion of the degree in which sickness prevailed at different periods. But in order to obtain a knowledge of the whole amount of deaths, those which occur on board of ships, as well as those at hospitals, ought to be ascertained. There were no means of collecting them till five years ago, when an instruction, under the authority of the Board of Admiralty, was promulgated, for all commanders of ships of war to transmit every year, on the first day of January, to the secretary of that office, an account of all the deaths that had happened, of men on board of their respective ships in the course of the preceding year. These accounts being deposited at the Admiralty, have formed the basis of the following statement.*

There were on board of ships of war in all parts of the world,

On the 1st of January, 1811,	138,581
1812,	136,778
1813,	138,324

Died of disease, killed, drowned, &c.

In 1810,	5183
1811,	4265
1812,	4211

From a calculation† founded on *data* furnished by this statement and by the Tables above referred to, it is deducible, that if the navy had been equally sickly in 1813 as it was in 1779, and if there had been no improvement in the treatment of the sick, the whole number of deaths from disease in the former year would have exceeded the actual number by 6674. Under such an annual waste of life, the national stock of mariners must have been exhausted in the course of the prolonged warfare from which this country has just emerged.

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* It would be a great improvement in these returns, if the deaths from disease were distinguished from those in battle and from accident; also, if the name of the disease were specified.

† As the number of seamen and marines employed in 1813 was double of that in 1779 (see Table I.) the mortality would also have been double, had the intensity of the sickness been equal at these two periods. The deaths therefore in 1813 at the Naval hospitals in all

It appears from Table II. that the most sickly years were those of 1779 and 1780. This will be accounted for by referring to Table III. and to the very intelligent and elaborate account of the sickness of these years in Illustration II. subjoined to this article, with which the author was favoured by Dr. Lind, (the worthy son and successor

parts of the world, would have been three thousand three hundred and thirteen, instead of nine hundred and seventy, their real number. There was no account taken of the mortality on board of ships in 1779, but it may safely be assumed to bear the same *ratio* to the deaths at hospitals as in 1813; and the deaths on board of ships being calculated on these elements, it will be found that in that year they would amount to three thousand and sixty-seven on the same number of men as in 1779. But as double* the number of men were employed in 1813, the number of deaths would likewise be double under the like treatment and intensity of sickness, and would therefore have amounted to six thousand one hundred and thirty-four: which, added to the deaths at hospitals, give a total of nine thousand four hundred and fifty; and subtracting from this the number that died at hospitals, and on board in 1813, there remain six thousand six hundred and seventy-four, as stated above, for the number of lives that may be said to have been saved this year, when compared to 1779. In making this calculation it has been assumed that the mortality of 1813 on board of ships, is equal to the average of the three preceding years; and only one half of the deaths on board of ships has been reckoned as referable to disease, there being good reason to believe that the other half is composed of those who have been killed in battle, drowned, or who perished by other accidents.

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* See subjoined Illustration I.

of the author of the Treatise on Sea Scurvy, and other works of equal merit,) joint physician with his father at that time to Haslar hospital.* The decrease of sickness since that year has been gradual, with the exceptions of the years 1783, 1796, 1797, and 1804, (see Table II.) The smallness of the number of sick in 1783, was owing to the greater part of that year being a time of peace; for though the greater number of the ships were put out of commission before the end of the year, yet the number of seamen having been voted prospectively the year before on the presumption of hostilities continuing, it was as great† as for a year of war. In the year 1796, the sickness, instead of decreasing gradually, fell *per saltum* as it were (see Table II.) This is satisfactorily accounted for by its being the first year in which the general supply‡ of lemon juice took place. The increase of sickness in 1797, (see Table II.) was owing to the irregularities connected with the alarming mutiny which broke out in the beginning of that year, and was not suppressed for several months. This serves as a proof how necessary subordination and discipline are to health. The increase of sickness and mortality in 1804 (see Table I.) was owing to the prevalence of the yellow fever in the West-Indies that year, in which the deaths at the hospitals at Jamaica and Antigua amounted to seven hundred and twenty-seven. It appears from Tables I. and II. that there was in that year a great decrease of sickness and mortality on the European stations, which was no doubt owing to the improved methods of preventing typhus fevers (See Dr. Baird's letter in the subjoined, Illustration III.)

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* This hospital stands on a point of land adjoining to Spithead, the roadstead near Portsmouth, and the principal rendezvous of the British navy.

† The number voted for 1783 was one hundred and eighteen thousand, but this measure was not carried into effect, peace having been concluded.

‡ This supply was not at first so general as it became afterwards, for it was afforded only to ships destined for foreign stations, or for particular services. The war which broke out this year with Spain interrupted the trade in fruit. It was afterwards very plentifully supplied from Sicily.

The principal diseases which constitute sickness and cause mortality on board of ships in all climates, are scurvy and fevers. To these may be added dysentery, which prevails much in most tropical climates, and above all on the Indian stations. Since these disorders have been subdued in the European stations, pulmonic inflammation has been the most frequent and fatal disease. (See Table V.)

The scurvy,* a disorder incident chiefly to a sea life, but by no means peculiar to it, has been nearly eradicated by lemon juice, or more properly the citric acid; for the juice of limes, Seville oranges, unripe China oranges, and in short of all the species of the botanical *genus citrus*, or the natural order of fruits called *Hesperidœi*, possess the same virtue. The second Table was constructed principally with a view to elucidate the beneficial effects of the general supply of lemon juice. This was known to be a remedy for the scurvy far superior to all others two hundred years ago, as appears by the writings of Woodall.† It is singular that this important fact should have been hardly known for more than a hundred years ‡ afterwards, when the late Dr. Lind, of Haslar hospital, revived and diffused this valuable piece of knowledge by his writings. It was this author who first clearly § stated the singular powers of this remedy in the cure of scurvy, for Woodall only affirmed that its virtues were far superior to all other remedies. Notwithstanding this, the navy continued to suffer severely from this disease, till the order for a general supply of lemon juice, twenty-seven years ago. This salutary measure was accomplished by a representation from the Medical Board of the navy in the year 1795, during the administration of Earl Spencer, from whose enlarged and benevolent mind every thing was to be expected. One of the most impressive parts of their argument, was built on the report of the effects of it in the Suffolk of 74 guns.* This ship sailed from England on the second of April 1794, and an experiment was made of supplying her with a quantity of lemon juice sufficient to serve out two-thirds of a liquid ounce every day, to every man on board. This was mixed with their grog, along with two ounces of sugar. She was twenty-three weeks and one day on the passage, without having any communication with the land, and arrived in Madras road, on the 11th of September, without losing a man, with only fifteen men on the sick list, all slight cases, and none of them affected with the scurvy. This disease appeared in a few men in the course of the voyage, but soon disappeared on an increased dose of lemon juice being administered. Let this fact be contrasted with the state of the Channel fleet in 1780 as described by Dr. Lind, (see the subjoined Illustration II.) which was over-run with scurvy and fever, and unable to keep the sea, after a cruise of ten weeks only: and let the state of this fleet be again contrasted with that of the Channel fleet in 1800, as described in the subjoined Illustration III. by Dr. Baird, which, by being duly supplied with lemon juice, kept the sea for four months without fresh provisions, and without being affected with scurvy.

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* See subjoined Illustration IV.

† His work is entitled "The Surgeon's Mate, or Military and Domestic Medicine, by John Woodall, master in surgery:" London, 1636, p. 165. He concludes his praises of it by saying, "I dare not write how good a sauce it is at meat, lest the chief in the ship should waste it in the great cabin, to save vinegar." See a still earlier testimony in Purchas's Pilgrim, p. 158.

‡ See the subjoined Illustrations, No. V.

§ Treatise on the Scurvy, p. 153 and 543. Third Edit. 1772.

It appears from the inspection of Table II. that during nine years of war preceding the general supply of lemon juice, the annual average of sick sent to hospitals, was one in 3.9 of the whole men in the navy, but that in the nine succeeding years, the proportion was one in 8.4. Other causes, particularly the improved methods by which fevers were diminished, contributed greatly to this decrease of sickness, so that it may be difficult to assign precisely what is due to lemon juice. But what admits of no ambiguity, is that, ever since the year 1796, scurvy has almost disappeared from ships of war, and naval hospitals. It will be seen from the subjoined copy of the printed form of returns, Table V. that scurvy is not even inserted there, as one of the heads of disease. One of the physicians of Haslar hospital has informed the author that he has seen but one case of it there, for the last seven years; and one of the physicians to Plymouth hospital reports, that only two cases have occurred to him the last four years. It will be seen, by comparing Table V., with which the author was favoured by Dr. Wilson, one of the Physicians to Plymouth hospital, with the like Table of Haslar hospital, at the interval of twenty-six years, what great changes there have been in that time in the number and quality of diseases, and particularly in the decrease of scurvy. It is found by the inspection of a great number of surgeon's journals, which I have made, that ever since the supply of this article, the scurvy has either not appeared at all even on the longest voyages and cruises; or if ever it did in a slight degree, it was soon made to disappear by an additional dose of lemon juice. The daily regulated allowance for each man is now one fluid ounce, with an ounce and a half of sugar. It appears also from the same journals, to be favourable to health in other respects; for some of the surgeons have given it as their opinion, that it tends to diminish the number of fevers and ulcers. The latter are observed to be much connected with a scorbutic habit. It is true that there are instances of ulcers prevailing on board of ships, in their most aggravated state, since the introduction of lemon juice, but without any connection with scurvy, but it was confined to particular ships and hospitals in which they were infectious.* The increased attention to separation, ventilation and cleanliness has since removed this evil, than which there was none more cruel to individuals, nor more embarrassing to the service.

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* See more concerning the first general supply of lemon juice, in Observations on the Diseases of Seamen, p. 490. Ed. 3. by Gilbert Blane, M. D. Lond. 1799.

Those only who have made themselves acquainted with the early part of the naval history of this country, or those who have perused the interesting, popular and eloquent narrative of Commodore Anson's voyage, in which the distresses and calamities, the dreadful sufferings and mortality arising from the sea scurvy are depicted, can duly appreciate the value of this simple remedy. The power it possesses over this disease is peculiar and exclusive, when compared to all other alleged remedies. It is *sui generis*—*Nil simile nec secundum*. Its efficacy may also be stated as singular when compared to that of any other remedy in any other disease. It is a certain preventive as well as cure: no other remedy yet known can ward off this dreadful scourge of mariners for an indefinite length of time under the use of salt provisions; nor does it produce any bad effects on the constitution like some other specifics in certain other maladies. It may therefore be affirmed with truth that it performs not only what no other remedy will perform in this disease, but what no known remedy will effect in any known disease whatever.†

There are some other species of fruit and vegetable acids, also saccharine substances in every form, and fermenting beverages which have considerable power in retarding the progress of this disorder for a limited time, but will not cure it under the use of salt provisions. A vegetable substance called nopal, the fleshy and succulent stems, and stalk of the *cactus opuntia*, which keeps well at sea, has been lately discovered in India to be an extremely salutary article of diet, and to resist scurvy; but the author read in the surgeon's journal of one of the East-India Company's ships, that in spite of the use of this, and of spruce beer at the same time, sixteen cases of scurvy arose, in one of which it was so severe as to prove fatal. All the mineral acids have been tried without effect. Had the peculiar virtue of citric acid been attended to when Commodore Anson fitted out the Centurion, and had a few gallons of it been sent on board of this ship in glass bottles, with a tenth part of spirits of wine to preserve it, all the misery which fills the reader of this narrative with so much commiseration and horror, and which was on the point of frustrating the object of the expedition, would have been prevented.*

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* See Observations on the Diseases of Seamen, p. 503. 3d edition.

† The author has never seen the scurvy resist the citric acid, and in the perusal of several hundreds of surgeons' journals, he has met with only two cases which seemed to resist it.

The liberal supply of fresh provisions and vegetables, with which ships have been furnished while in port, during the late war, has also contributed much to counteract the scurvy, for formerly this disease was not confined to long voyages and cruises. It appears from Dr. Lind's statement, that one thousand four hundred and fifty-seven men ill of scurvy were sent to the hospital from the Channel fleet in 1780, and it has been known to arise in ships while at anchor under the daily use of small-beer. Nay, it has been known to arise among prisoners of war living entirely on fresh diet, and solely imputable therefore to confinement in bad air, a dull uniformity of life, depression of spirits, and indolent habits naturally belonging to a state of captivity. This happened at Portchester Castle and Norman Cross towards the beginning of the revolutionary war, before those arrangements were put in practice, which afterwards so effectually secured their health. The like happened about the same time in a prison ship adjoining to Portchester Castle, but it was remarked to break out sooner, and to a greater degree in the ship than in the castle.*

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* Anson's ship the Centurion left England with 400 men: there were 200 surviving on her arrival at Juan Fernandez, of whom only eight were capable of duty. In a very few days there would not have been strength remaining to carry the ship to her anchorage, and she would have been left adrift on the Pacific Ocean, in the same manner as the Oriflamma, a Spanish ship on her passage from Manilla to Acapulco, some time in the last century, in which the whole crew perished from disease, and in this state she was discovered with the dead bodies on board. This is a voyage of six months, being made against the trade winds. The ships employed in this service have of late years been perfectly healthy, by being abundantly supplied with the citric fruits. The author owes this information to Capt. Mendoza y Rios, to whom navigation is so deeply indebted for the incomparable Nautical Tables which he has constructed, and which he is still farther improving. Anson sailed from St. Catharine's the 28th of January 1741, and arrived at Juan Fernandez the 10th of June following, so that he was one hundred and forty-three days from the last place of refreshment, whereas the Suffolk was one hundred and sixty-two days under the like circumstances without losing a man, and without having any man ill of scurvy, or any other dangerous disease on her arrival in India.

The year 1796 may therefore be considered as an era in the history of the health of the navy. But there appears† to have been another sudden decrease of sickness in the first years of this century. This is to be ascribed to the improvements in the method of promoting ventilation and cleanliness, and particularly to the strict‡ discipline adopted and enforced in the Channel fleet. Air contaminated by foul and stagnant exhalations, particularly those from the living human body, is the ascertained cause of typhus fever, known also by the name of the jail, hospital and ship fever, which has been a more grievous and general source of sickness and mortality in the navy, than even the scurvy. The dysentry, which stands next in order in point of fatality, is also generated and propagated by the want of cleanliness and ventilation.

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* See also a curious instance of scurvy arising at land under the use of fresh provisions, in an article by Sir James Macgrigor, in the Med. and Surg. Journal of Edinburgh for 1805, page 282; also in the Trans. of the Coll. of Phys. Vol. II. and IV. and Trans. of Med.-Chir. Society. Vol. IV. page 141. It appears from Pliny, that this disease affected also the Roman armies in Germany. There is reason to believe that the scurvy will not arise in any circumstances under the use of fresh animal food, provided fresh vegetables are used at the same time. Farinaceous food, though of a vegetable nature, will not have the same effect.

† See Tables I. and II.

‡ See the letter from Dr. Baird in the subjoined Illustration III.

The infection of fever is generated by the breath and perspiration of men, crowded for a length of time in confined air, and without the means of personal cleanliness, particularly from the want of shifts of linen. The methods which have of late been practised with such decided success, in combating these evils on board of ships have chiefly been;

First: Regulations respecting personal cleanliness. A frequent inspection is made of men's clothing, to ascertain whether there is a sufficiency for the purpose of cleanliness, and of protection from cold: the regular washing of apparel is enforced, and two sets of hammocks are provided, in order that one may be scowered while the other is in use. It is greatly to be lamented that the want of a regular and adequate supply of soap is still a bar to these measures being carried into due effect, nor is it easy to account for the omission of a supply of such obvious and great utility, and of which the expense would be manifoldly compensated by the improved health of the men.

The chief source of infection used to arise from the method in which new raised men were treated, by being crowded on board of small tenders and receiving ships, for a length of time before they were distributed to their respective ships. The alarming state of sickness in the American war, induced the Navy Board, over which Lord Barham then presided, to institute, in 1781, what were called *slop ships*,* on board of which new raised men were conveyed, in order to be inspected, cleaned, and supplied with new clothing before being distributed, and to be conveyed to their ships not in small tenders as formerly, but in large men of war.† It was owing to the want of such regulations that the navy used to be most lamentably infested with fevers at the commencement of wars, from the manner in which impressed men were treated, and it is from a change of system in this respect that we are to account for the great difference in sickness in the year 1794, the first year of the revolutionary war, from that in 1779, in the great armaments on occasion of the war with France, Spain, and the Colonies. (See Table II.)

Secondly: the improvements in the ventilation, cleanness, and dryness of ships. The want of cleanness will hardly produce disease, unless when combined with want of ventilation. What are called wind-sails, that is, wide tubes formed of canvass, and extended by hoops into the form of a cylinder, which pass from the external air into the lower parts of the ship, through the hatches, have been in use time out of mind, for freshening the spaces between decks. But these are very imperfect ventilators, for they cannot be let down in bad weather when the hatches must be shut, at which time they are most wanted. They also admit such large volumes of cold air, that they cannot with safety be introduced to those spaces where the men are asleep. In order to obviate these imperfections, it has been common for the last thirty years to put in practice a contrivance borrowed from a French frigate,* consisting of square wooden trunks, for which brass tubes have since been substituted, running from the hold or lower deck and terminating in the open air. Instead of air tubes in this situation, it has of late been judged more adviseable to place a funnel vertically, near the middle line of the ship before the fore-mast, leading through the forecastle deck. All ships are now fitted in this manner, and the great importance of it will be obvious, when it is recollected that in this deck there is neither hatchway nor ladder, and that the sleeping places are under it.—The removal of all offensive substances by sweeping and scraping, has been much more accurately attended to than formerly; but the washing of decks, particularly in cold and damp weather, has been much less practised. On the contrary, dryness, so essential to health and comfort, has been more studied, and rubbing with hot sand, scraping and portable fires have been found much more salutary operations, than frequent washing. Though there seems little to fear with respect to health from the exhalations of pure water, whether salt or fresh, yet there can be no doubt of the bad effects of the diffusion of moisture in circumstances where it cannot be readily dried up, for it promotes mouldiness, putridity or rust in the several perishable objects with which it comes in contact. Dryness therefore is deservedly held to be a matter of primary consideration in the economy of a ship, as well with a view to health and comfort, as to the preservation of all the valuable articles of victualling, clothing, utensils, and arms. It is essentially promoted by portable fires carried all over the ship, when most wanted, in iron stoves, which have been much in use for this purpose for some years. The use of iron, now so general in all the implements and machinery subservient to human life, is also employed for various uses on board of ships. It was about two and thirty years ago,† that fireplaces of cast iron were first introduced in room of the brick-work, of which they were formerly constructed, and there is another application of iron, still more recent and important, which now comes to be mentioned.

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* Slop is a trivial name for the various articles of seamen's clothing, such as jackets, shirts, and trowsers.

† On the 13th of March 1787, the House of Commons called for an account of the impressed men who had died in the course of the American war, before being distributed to ships. The number returned was 180, as taken by the author from the original document deposited at the Journal-office of that House.

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* See Diseases of Seamen, p. 266. Ed. 3.

† This was first written in 1815.

One of the most prolific sources of foul air and bad smells in ships has been the putrescent matters absorbed and retained by gravel, sand, and other earthy substances, heretofore used for ballast. It is now found that these can be dispensed with, having been superseded by a recent invention, now coming into general use. Some part of the ballast has at all times consisted of small masses or pigs of iron, but at present little else is used expressly for that purpose, what is farther required to give the requisite steadiness to the ship, being made up by the weight of the iron tanks now substituted for the lower tier of water-casks, and placed over the iron ballast. These vessels are cubes of four feet in dimensions, each of them capable of containing about two tons of water. This invention has in other respects a beneficial influence on health. Iron not being corruptible like wood, imparts no bad quality to the water, and by its durability ensures a more certain and ample supply; for the utmost distress has been known to arise from the decay of casks on long voyages and in remote parts of the world, where they cannot be replaced. The quantity that can be laid in at once in fitting out, is also more abundant, than could be done by means of casks, a point of great importance to health on long voyages and cruises. A great deal of dangerous labour is also saved by this substitution; for these tanks are never removed, being filled and emptied by means of a forcing pump and a hose; whereas the hoisting up of casks from the hold at sea, was one of the hardest and most dangerous duties of seamen, while it was also injurious to health, being performed in the midst of foul air. It has been truly remarked, that seamen are affected with ruptures* above the proportion of men in general: and next to the violent pressure made on the abdomen, while seamen are lying on the yards, in the act of handing and reefing sails, such accidents may be chiefly imputed to the severe strains to which men are exposed in removing water casks from the hold for daily use at sea. The play of the machinery also employed in this operation has given occasion to severe and dangerous accidents.

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* The following account of the supply of trusses for the navy will

Under the head of late improvements, conducive to the purity of air in ships, there falls to be mentioned another very recent and very important invention which has been adopted in their construction. This improvement was suggested and put in practice by Mr. Seppings, surveyor of the navy, and has been explained by him in the Philosophical Transactions for 1814. The purpose of the contrivance is to add to the strength, solidity and durability of ships, and it is effected by the obliquity of the materials, and by filling up certain intervals and cavities with pieces of wood, caulked and pitched. It would be out of place here to enter into the merits of this plan, except in so far as relates to health, to which it is incidentally and collaterally conducive in a variety of ways. First, by the obliteration of those cavities under the floor of the hold which used to be the receptacles of filth and of all manner of vermin dead and alive, proving perpetual reservoirs and sources of foul air and of offensive and noxious exhalations. Secondly, there is a circumstance in this form of construction still more favourable, if possible, to the purity and freshness of the air in the lower parts of the ship, so as in a great measure to supersede all other methods of ventilation.

convey an idea of this. During the last eight years, the average annual supply of trusses has been two thousand eight hundred and seventy-three single trusses, seven hundred and forty-three double trusses, and in the course of the last three years, ninety-eight bag trusses have been supplied to the navy. The trusses now preferred are those called *self-adjusting*, as they have been found to afford greater security than those formerly in use, to men employed in hard labour, who from their exertions and postures would be liable to a recurrence of the complaint.

This consists of certain intervals left between the timbers of the frame which run up the sides of the ship, maintaining a constant communication of the open air with the hold and the spaces between decks. Thirdly, by virtue of this construction also a ship becomes less liable to leakage; so that by this and the new method of ballasting, all the unwholesomeness and offensiveness belonging to bilge water is done away: and it will appear hardly credible to succeeding generations, that the air in the well of a ship used to become so contaminated, as in innumerable instances to produce instantaneous and irremediable suffocation. Two instances occurred to the author's own observation at Jamaica, in the year 1782. Two ships of 74 guns, fitted in this manner, have lately returned from sea* to be paid off; and it appears from their medical journals, that they have reaped every advantage with regard to health that could be wished or expected. The Albion, in the course of eleven months, during three of which she was engaged in winter cruises on the coast of America, the most rough and trying service in the world both for ships and men, had on an average no more than five on the sick list of a crew of 490 men; no infectious disorder arose; the only deaths from disease were one from pulmonic inflammation, which was by far the most prevailing complaint, and one from erysipelas; twelve were sent to the hospital, none of which were cases of fever, flux, or scurvy. Of this small number, the only serious cases were those of small-pox, consumption, and pulmonic inflammation. This ship was also fitted with iron tanks. The Tremendous, in the course of twenty-two months, employed chiefly in the North Sea, had no case of fever, flux, or scurvy, and only two deaths happened, one from pulmonic inflammation, and one from inflammation of the liver; nor did any infectious disorder arise, except the mumps†

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* This was witten in 1815.

† It is not uncommon for this complaint to spread in ships of war. See Transactions of a Society for the Improvement of Medical and Chirurgical Knowledge, Vol. III. p. 431.

(cynanche parotidea,) of which there were sixteen cases: the great majority of complaints were catarrhs: twelve were sent to hospitals, of which the only important cases were those of anasarca and pulmonic inflammation.

In reviewing the various ways in which these new methods of fitting ships of war affect health, it is truly pleasing to contemplate that admirable harmony by which every thing that is most perfect and excellent in subjects of art, as in the arrangements of nature, tend in all their bearings and influences to bring about the most salutary ends.

There is still another recent contrivance, which, though much less important, is in proof of the same principle, and is deserving of notice, as well from its having some influence on the purity of the air, as to demonstrate how much the human intellect is awakened and exercised in this age and country in all manner of useful inventions. What is alluded to, is the illuminators, or bull's eyes, as they are vulgarly called, consisting of thick portions of glass, in form of the segment of a sphere, inserted in the ports and decks for the admission of light in bad weather, when all the inlets of light and air are barred up. They afford great accommodation, particularly to small ships in the day-time, by superseding the use of candles, which are dangerous from the risk of fire, and tend to contaminate the air, already too close and foul.

There are some other points conducive to health in the present arrangements of the navy, which remain to be adverted to. The chief of these are the superior and excellent quality of all the articles of victualling; the plentiful supply of fresh meat and vegetables, while ships are in port, or within reach of it, as in the fleet stationed off Brest; the supply of as much wine as is equivalent to one half of the allowance of spirits; the use of cocoa for breakfast, and the general practice of vaccination.

The only head of improvement still remaining to be added to the enumeration in the present system of conducting the navy with regard to health, is the superior treatment of the sick. In the course of the last twenty years, the supply of medicines, and of the several articles of nourishment, has been greatly improved in quantity, quality and selection: there has also since that time been appropriated to the sick a supply of bedding and other necessary articles conducive to cleanliness and comfort, and essential to their recovery. These arrangements began about twenty years ago, and have been gradually improved upon by the zeal, humanity and good judgment of the officers, civil, military, and medical, attached to the sea-service. A great improvement has been made in the situation, fitting and furniture of the *sick berth*, as it is called. The spot appropriated to the sick in ships of the line was formerly in the fore part of the lower gun-deck, a situation damp, ill-aired and inconvenient. Its place is now under the forecastle, furnished with all the requisites of an hospital, and with access to the head for necessary purposes. There are now therefore ample means of treating the diseases and wounds of men on board of their own ships, whether at sea or in harbour, which it was neither safe nor practicable to do in former times, when infection was rife; when the accommodations were unfavourable to recovery; when the supply of medicines and necessaries was inadequate; and when there was a deficiency of medical and chirurgical skill.

It is from this that we can trace the late increased ratio of mortality at the hospitals, as appears in Table I. No slight cases are now sent to the hospitals as formerly, such cases being retained and cured on board: there are now no cases of scurvy, all of which, except such as were in the last extremities, or were complicated with other complaints, recovered at the hospital.* The sea service has also profited no doubt by the generally improved state of physic and surgery, and the encouragement so judiciously and liberally afforded to the medical service of the navy, under the administration of the late Lord Melville, by additional pay and the gratuitous supply of all the medicines,* which cannot fail to have attracted candidates of superior talents and education.

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* It ought further to be remarked, in justice to those who have the charge of these institutions, in order to account still more satisfactorily for this late increased proportion of mortality, that it has not been

The causes of the improved state of health of the British navy appear therefore to consist in the ample and general supply of lemon juice, the superior attention to cleanness, dryness and ventilation, the improvement in victualling, vaccination and superior medical treatment.

The moral effect of all these ought not to be overlooked. The encouragement administered to men's minds by kind treatment, and the anxious desire of officers to supply all their wants in sickness and in health, while they prove an inducement for good men to enter the service, cannot fail to add to that alacrity and spirit so favourable to health, and which have produced results in the course of the last twenty years, which will be proudly recorded in the annals of the country. And by a reverberated influence as it were, the contemplation of these great events, the fruits of successful valour, beget an elevation of mind still farther conducive to the sound state of the body, while it exalts and confirms those sentiments of patriotism and loyalty, which, backed by discipline and martial ardour, have so eminently distinguished our fleets and armies in the late contest. And we hope it will be admitted that the medical art has contributed its due share towards those resources by which this country has been saved, and Europe delivered in the late war, a war unexampled in its duration, extent

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the practice for some years past, as formerly, to lodge the invalids in the hospitals on their arrival from abroad, for these, while they swelled the numbers, gave a smaller result of mortality.

* Surgeons formerly found all their own medicines. A gratuitous supply of the principal medicines was directed in 1796, and an entire supply of them in 1804.

and violence; and not less remarkable for the momentousness of the interests at stake, and the arduousness of the struggle, than it will be memorable for the final and complete success with which it has been crowned.

Much praise is due to the government of the country, and to the officers of the navy, for bringing about these salutary changes. It does not appear from the history of ancient times, nor of modern times till very lately, that the means of preserving the health of those engaged in war, whether by land or sea, was either studied or understood. We hear little or nothing of the medical establishments in war, among the polished* nations of antiquity, nor in the early history of Christendom; far less are they to be expected among barbarous nations, whether ancient or modern. It must however appear clear to every reflecting mind, that the care of the sick and wounded is a matter equally of policy, humanity and economy. Independently of men being sentient beings and fellow-creatures, they may also be considered as indispensable mechanical instruments. But in former times they had not the attention paid to them, which would have been due even to inanimate machines of equal utility; for there seemed to be much more anxiety about preserving arms from rusting, and cordage from rotting, than about maintaining men in an effective state of health.* This cannot be asserted with regard to the sentiments and practices of the present officers of the navy, among whom there prevail enlightened and comprehensive conceptions of duty, arising out of a general diffusion of zeal, intelligence and humanity ; which, seconded by the like qualities in the civil authorities and the medical officers, has carried the health of the navy to a pitch, which the most sanguine well-wisher to the public welfare would not have ventured to predict five and thirty years ago.

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* Xenophon, Cæsar, and Polybius, who give the most minute details of war, make no mention of hospitals for the entertainment of the sick and wounded; nor does Vegetius, in his Treatise on the Art of War, ever touch upon this subject, but one of his commentators mentions, that each Roman legion (between three and four thousand men) had one medical officer attached to it, and that Augustus Cæsar, in compliment to the profession, and in gratitude to his physician, Antonius Musa, under whose care he had recovered from a severe illness, decreed that these officers should in future be exempted from military duty. Vid. Vegetii de Re Militari, l. ii. Godescalci Stewechii Commentarius. Somewhat of a piece with this is what we find in Rymer's Fœdera, that Henry IV. of England, in equipping his expedition against France in the beginning of the fifteenth century, gave an order that those who were employed as surgeons should also serve as archers.

The result of this has been not only to afford a great additional number of effective hands towards the accomplishment of those great ends for which navies are created and destined, namely, public defence, and the annoyance of the enemy, not to mention that naval renown of which as a nation we are so justly proud, but to promote economy to a degree which will appear incredible to those who have not paid close attention to this subject. It is computed that two ships of war are capable of more service by the present system, than three of the same rate in former times. Here is a saving of one third of the total amount of the national expenditure, besides what is saved in the recruiting service, which has been officially calculated to amount to fifteen pounds for each man, and of hospital expenses, which are estimated at five pounds for each man. This computation is exclusive of the higher bounties which would have been necessary under the reduced stock of seamen, which a high rate of mortality would have produced. Nay, it appears clear from what has been before stated, that if the mortality during the twenty years of the revolutionary war had been equal to what it was in 1779, the whole stock of seamen would have been exhausted ; in which case men would not have been procurable by any bounties however exorbitant; for it has been stated, that if the mortality of 1813 had been equal to that of 1779, there would have died annually six thousand, six hundred and seventy-four men more than have actually died: which in twenty years would have amounted to 135,480, a number very nearly equal to the whole* number of seamen and marines employed in the last years of the late war.

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* There was no article in the public instructions issued to naval commanders, respecting ventilation and cleanliness, till the edition promulgated in 1806.

It must not be concealed, however, that the present rate of mortality of the navy, low as it is compared to what it was formerly, is very high when compared to that of subjects of the same age, in other situations of life. It will be found by calculations founded on the statement at page 2, that the average rate of mortality for the three last years of the late war has been one in 30.25. This is a high rate for men of an age from twenty to forty years, of whom the great majority of seamen and marines consists. The Northampton Tables give a mortality of one in fifty-seven in this class of subjects, and these were constructed at a time when the general rate of mortality in England was greater than at present. From a computation founded on the experience of the last forty years, in the Equitable Assurance Office,† it appears that the mortality of persons at this age does not exceed one in one hundred and thirty. This calculation, however, is made on select cases, none but good lives being insured. From the best computation that can be made, the mortality in this class, in the general population of England, is about one half the mortality of all ages, and this being one in forty-nine, according to the population returns of 1811, the mortality of subjects from twenty to forty ought to be one in ninety-eight; but as the decrease of mortality seems to be chiefly in infants (certainly so in the metropolis), and as consumptions have been observed to be more frequent of late among young adults, probably from a greater number of sickly children being saved, this rate of mortality is perhaps too low: it cannot be far wide of the truth, if we take it at one in eighty. But, be this as it may, one in thirty is a very high rate of mortality; especially when it is considered that they are in some measure select cases, no sickly or unsound persons being admitted into the navy. In order, however, to make the comparison still more fair, a deduction of those who are killed in battle, or perish by drowning or other accidents inseparable from a life at sea, should be made from the naval deaths. There is good reason to believe that these violent deaths constitute one half of the mortality on board of ships of war. This will reduce the mortality from disease, to one half of what was stated. But on the other hand, in order to make a just calculation of the total rate of mortality, the deaths at hospitals ought to be included. In the year in question, 1813, the deaths at hospitals in all parts of the world amounted to nine hundred and seventy-seven. (See Table I.) These being added to the deaths on board from disease, and the number of men employed in that year being divided by the sum, the total mortality will appear to be one in forty-two, which is about double of that of subjects of the same age in civil life. It is greater than even that of prisoners* of war, which in 1813 was one in fifty-five; as appears by an account extracted from the public returns. It is also higher than that of the garrison of Gibraltar,† which is one in forty-eight, exclusive of the years in which the epidemic fever prevailed.

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* See page 2 et seq.

† Mr. Morgan, the very diligent and scientific actuary of this office, was so kind as to furnish the author with this information.

It is a matter deserving of serious consideration, therefore, how far it is possible to improve still farther the health of seamen. The air at sea is more pure and salubrious than any where else. Nature therefore has done much; and as there is abundant proof of the power of art to controul the causes of disease, there is great encouragement in attempting something further in behalf of the health and lives of this most valuable class of subjects.

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* See subjoined Illustration VI.

† See Medico-Chir. Transactions, Vol. V. p. 334.

In order to effect this, it will be necessary to ascertain clearly what are the principal causes of disease, still existing in the navy.

From the examination of surgeons' journals, and hospital returns, it appears that the chief sources of mortality in the navy of late years have been pulmonic inflammation and fevers in temperate climates, and fevers and dysenteries in tropical climates. By the returns of the hospitals at home, a specimen of which is exhibited in Tables IV. and V. it appears that pulmonic inflammation constitutes the largest head of mortality. This will farther appear very striking by comparing the proportion of pulmonic cases in the late returns of Haslar and Plymouth hospitals, and Dr. Wilson's enumeration of diseases, with that in Dr. Lind's statement in 1780. These late cases are chiefly pulmonic consumptions, the *sequelæ* of pulmonic inflammation which had occurred at sea. The chief circumstance in a seaman's duty which exposes him to this inflammation, is his being suddenly called from the too warm and close situation in which he sleeps, to take his watch in the night upon the deck, or aloft. As this has always been the case, it may be asked how it happens that such complaints have been more frequent of late? The most rational answer to this seems to be, that, as the constitutions of seamen are now entirely free from scorbutic taint, and in a great measure from the debilitating influence of febrile poison, more sound and vigorous also from improved diet, cleanliness and ventilation, and at all times breathing a bracing atmosphere, they are more prone to diseases of pure inflammation than formerly. In illustration of the superior purity of cool air being favourable to pulmonic inflammation, it may be alleged that the inhabitants of Swisserland, Savoy, and Sweden, are remarked to be more liable to these than the rest of Europe. If we were to reason farther upon it, an explanation might also be derived from that principle of the animal economy, by which it is found that the presence of one disease is in a great degree incompatible with the existence of another. Whatever the cause may be, the fact is undoubted. With regard to fevers, they are by no means subdued to the same degree that scurvy has been. In some of the last years of the late war, there occur in the surgeons' journals some examples of fever being generated and propagated in ships, to a great extent. In a 90 gun-ship, cruising in the Channel in 1805, there occurred a hundred and seventeen cases of fever, five of which proved fatal. Intemperance also is occasionally unavoidable, particularly in port. In an 80 gun-ship which had been for some time at Plymouth in 1806, during which the men had indulged to excess in spirituous liquors, a fever broke out on her first going to sea, with which a hundred and six men were seized, of whom ten died. Such excesses are still more pernicious in tropical climates, and this, combined with other causes, has in the late war been productive of the most dreadful mortality. It appears, for example, from the first Table, that in the year 1804, while there was a high degree of health in the navy in Europe, there was an extraordinary loss of lives from disease in the West-Indies.

It remains to point out the means of counteracting these very serious evils. And first, with regard to pulmonic inflammation, which has been imputed to the too great heat and closeness of the places in which the men sleep, whereby they are generally in a state of perspiration when called into the open air, the utmost benefit would arise from rendering those spaces cooler. This should be done so as to avoid streams of cold air, which could easily be managed by the construction and due distribution of air-pipes, such as have been already described. But when Mr. Seppings's* construction shall be universally carried into practice, no other provision for this purpose will be necessary. The extreme of cold ought equally to be avoided during sleep. Many pulmonic affections are caught by men falling asleep in the open air, on their watch. Proper clothing, particularly the wearing of flannel next the skin in cold climates and seasons, is an essential precaution against such inflammations, and it is almost unnecessary to mention that men should be induced, when practicable, to shift their clothes when wet, as one of the most material precautions against catarrhal affections, with which pulmonic inflammation generally commences.

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* This gentleman was then Surveyor of the Navy, and since better known by the title of Sir Robert Seppings, having been knighted for

Secondly. With regard to typhous fevers, it is plain that the well ascertained methods of preventing them, admit of a still higher degree of practical energy by a still more strict enforcement of separation and cleanliness. It is also evident that no degree of discipline nor internal œconomy can prevent or destroy morbid *effluvia*, and ensure the purity of air in a ship, till Mr. Seppings's improved construction and the new method of ballasting shall become general; nor till an ample and regular supply of soap shall be furnished. With regard to this last article, it is quite unaccountable how any thing so obvious should have been so long overlooked. The only conceivable objection is the expense that would be incurred. This could be obviated by its being supplied in the manner of slops and tobacco, that is, charged against the seamen's wages. But were it to be supplied at the expense of the state, it would be an inadequate statement and a narrow view of its benefits to say, that there would be a tenfold pecuniary saving in the tear and wear of men. Seamen are frequently not only censured but punished for want of personal cleanliness, in circumstances in which they are without the means of practising it: for on foreign stations there is not every where a market, and if

the great ingenuity he displayed in some new and highly important improvements in the construction of ships.

: were, seamen are generally in want of money to pur-
e it, no part of their wages being payable abroad.
en this supply shall be granted, of which there can be
oubt in this humane and enlightened age, one half of it
ld consist of that sort of soap which is made with a
le proportion of soda or barilla, as it answers remark-
well for scowering coarse articles with sea-water.

hirdly. With regard to intemperance, naval officers are
lly persuaded of its baneful tendency, that no exhorta-
on this subject seems necessary. It is only to be wished
the possibility of abusing spirituous liquors were re-
ed, this form of fermented liquors being more adverse
ealth than any other, and from the comparative small-
of their volume, their abuse is more easy, and their
ealment less liable to detection. Much benefit is de-
ble from the late practice of substituting an equivalent
ine, for one half of the spirits; and still better effects
been experienced from an entire supply of wine,* to
xclusion of spirits. Intoxication not only renders men
ective while under its influence, but ruins their consti-
ns, excites and predisposes to fevers, and gives occasion
rious mechanical injuries of the most serious nature
endency. The great proportion of maniacs† among
en is chiefly owing to injuries of the head, received in
te of intoxication, as might be naturally expected where
rain is already in a state of disturbance.

ea is an article universally grateful to the British popu-
n, and has to a certain degree supplanted intoxicating
rs, in all ranks, to the great advantage of society. It
ld be wise therefore to encourage the farther use of it
e navy, there being no solid objection to the salubrity

To those who declaim against its supposed relaxing
erty, it may be answered by asking whether British

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ee a very striking example of an entire supply of wine, in Ob-
ions on the Diseases of Seamen, pages 51 and 83. 3d Edit.
ee subjoined Illustration VII.

courage and hardihood appear in the late exploits by sea and land less splendid than at Cressy or La Hogue, whether there is to be found in the results of the battles of Trafalgar and Waterloo, any proof of British nerves being unbraced by the habitual use of this beverage, and whether the physical and moral energies of our officers and men will not stand a comparison with those of their forefathers or of their enemies, neither of whom were drinkers of tea.*

Fourthly. A great proportion of the mortality of the navy, is referable to the diseases peculiar to tropical climates, particularly in the West-Indies. Yet there are incontrovertible proofs, that fleets may serve on this station in a state of health, equal to that of any other part of the world. In the month of April 1782, in a fleet of thirty-eight ships of the line and three frigates, manned with twenty-three thousand men, the deaths from disease were, of fevers, fifteen; of dysentery, seven; of scurvy, two; of small-pox, six; of mortification, one; of consumption, one; of general debility, one; in all thirty-three, and only ninety-seven were sent to hospitals. After the celebrated battle of the 12th of that month, the whole of this fleet rendezvoused at Port Royal, in Jamaica, and the greater part of it remained at anchor there during the following month of June. During this month, in thirty-two ships of the line and one frigate, there died of fever, an hundred and thirty-four; of dysentery, fifteen; of scurvy, none; of various other complaints, six; in all, an hundred and fifty-five. Not quite an hundred were sent to hospitals, and the majority of these were cases of fever. The mortality, therefore, was more than four times greater than it was to windward, which was chiefly owing to the following causes:—first, The watering duty, on which the men caught the bilious remittent, or endemic fever of the climate; secondly, The clearing and fitting of the French prizes, then in an extremely filthy state, from which they caught the yellow, or contagious fever *(typhus icteroides.)* The writer finds, on consulting the notes which he then kept as physician to the fleet, that he first perceived the contagious nature of this fever, from observing, that those men who caught the fever, or were taken ill after returning to their own ships, by having been exposed to the foul air of the French ships, communicated it to their medical and other attendants:* thirdly, the greater facility of procuring spirituous liquors, for intoxication, particularly with this species of fermented liquor, renders the body much more susceptible from all the causes of fever.

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* It appears from Lord Liverpool's speech on the agricultural distresses on the 26th February 1822, that the consumption of tea had greatly encreased in England the last thirty years, for the total in 1787 amounted to sixteen millions of pounds, but to twenty-two millions in 1821.

But the mortality of seamen in the West-Indies during the American war was trifling, when compared with what it has been at different times in the course of the late revolutionary war. It appears by records kept at the Admiralty, that the naval force in the West-Indies in 1804, fluctuated from nine thousand to thirteen thousand in ships of all classes; whereas in 1782, in which there was a greater naval force under Lord Rodney than there had ever been before or has been since on any foreign station, the strength of this armament fluctuated from twenty-four to twenty-five thousand men. Yet on casting our eye on Table I. it appears that there died more in the hospitals of the West-Indies in 1804 than in 1782. This statement is still stronger, when it is considered, that those who died of wounds are included in the amount of deaths in 1782; whereas, in 1804, there was no action at sea. The mortality, therefore, was about three times greater in the latter than in the former period. It appears from the surgeons' journals on that station at that time, that there was a proportional mortality on board of ships. In one frigate, there were one hundred and seventy cases of fever, of which twenty-six proved fatal on board.

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* This subject is well illustrated by Mr. Pym, Deputy Inspector of Hospitals, in a work entitled Observations on the Bulam Fever, London, 1815.

In order to recommend measures of future precaution, let us, if possible, detect the causes of this very great difference of sickness and mortality at different periods on the same station.

It is observable, that the mortality in fleets in the West-Indies, has been by far most severe in those wars in which there were great expeditions by land, as in that against Carthagena in 1740, and those against Martinique and St. Domingo in the first years of the revolutionary war. There was no large army transported from England, nor any expedition of importance undertaken during the three years in which Lord Rodney commanded in the West-Indies. It is to this we trace the great difference in point of health at different periods. The vessels that used to be hired for transports, were for the most part very ill adapted to that service, generally over-crowded; and during their long passages, in consequence of contrary winds and other obstacles, almost all of them arrived in the West-Indies in a sickly state, from stale provisions and scarcity of water; but above all, from accumulated infection. When the typhous poison exists in a slight degree, a warm climate dissipates it; but when in a concentrated state, it is exasperated by the heat of the atmosphere, and by the paludal exhalations which universally exist in the vicinity of West-India harbours: and it has been matter of observation that troops which were disembarked from the most crowded and infected of the transports, were those men who, though they had escaped illness on the passage, were attacked soonest and most malignantly by the fever of the climate. It ought also to be remarked, that the causes affecting the health of the troops in 1795 and 1796, were greatly aggravated by a fever then prevailing, generated in a ship which arrived in the islands in March 1793, under peculiar circumstances of long protracted crowding and foul air. And it may here be farther remarked, that malignant febrile infection has probably been kept up by being imported from time to time in slave ships, during those ages in which this traffick existed, the circumstances in the middle passage being such as were likely to generate contagion. The evils connected with the conveyance of troops have in a good measure been avoided by the attention of the Transport Board, in making better regulations; but more particularly by the employment of ships of war for transports.* This was eminently exemplified in the expedition to Egypt in 1798; for many of the troops, from various causes of delay and change of destination, were six months on board of ships, yet disembarked at the Nile, in perfect health. The obvious remedy of the very serious evils from the old system of transports† is the observance of those rules of ventilation and cleanness, which have been already amply described and dwelt upon.

The other principal cause of sickness in the West-Indies, is the going on shore, whether for the purpose of wooding or watering, whereby they are at all times exposed to the endemial *miasmata*, or for any other purpose, whereby they may mix with the population, and inhale the morbid human effluvia, during those times in which epidemic fevers prevail. All such duties should be performed ‡ by hired negroes, against which there can be no conceivable objection, but an economy demonstrably false, if there is any truth in the general scope of what has been said on this subject. It appears clearly from several incidents connected with the lamentable mortality in the West-Indies in the end of the last century, and the beginning of this, that mortal diseases were contracted by seamen, not only by the wooding and watering duties, but simply by going on shore to the sea-port towns where infection existed: for ships have been known to be exposed to the atmospheric heats of Africa, and other tropical regions, with impunity; but upon arriving at a port in the West-Indies, and some of the men going on shore, the most fatal epidemic immediately broke out.*

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* See a luminous exposition of the advantages of employing King's ships in the transport service in the speech of the late Lord Melville, in parliamentary debates for May 1810.

† See subjoined Illustration VIII.

‡ The author has learnt since this went to press, that this has been practised for some years at Jamaica, with every advantage that could be wished.

The only other remark that remains to be made on this subject is, that the abuse of spirituous liquors is vastly more pernicious in that climate than in cold and temperate climates. One main cause of the unexampled health of the fleet to windward in 1782, was the extraordinary vigilance exercised in precluding all access to this poisonous cordial. The admiral carried this so far as to send armed parties round that district of St. Lucia which lies adjacent to Gros-islet Bay, where the fleet lay at anchor, with orders to break all the stills that could be found, the island being then under martial law.

Fifthly. The last means to be proposed for farther promoting the health of seamen, is a more ample supply of articles of nourishment for the sick and convalescent. It is not enough that they be supplied with such small messes of refreshment as are fitting and necessary for a sick bed: the list of articles already provided is well selected, and sufficient for this purpose; but there are still wanting the materials of adequate and substantial diet, adapted chiefly to convalescents. It may be answered that the portable soup answers this description; but this has never been a popular article of nourishment among seamen, nor is it sufficiently hearty, solid, or abundant for the purpose of recruiting strength. There is a new method of preserving fresh provisions not only in an uncorrupted state, but with their sound and natural flavour for several years, which has stood the most satisfactory test of experience, and is well known to many officers of the navy as an article of sea-store. I have myself found meat preserved in this manner perfectly sound and well flavoured after a lapse of six years. This method* was invented and brought into use a few years ago by Mr. Appert. A quantity of provisions preserved in this manner sufficient for the sick and convalescent, might be furnished at a very moderate expense, and the form of preparation is so simple, that such a compendious and cheap method of managing it on a large scale, will probably be fallen upon, as to render it occasionally available to the whole of a ship's company. It is needless to enlarge here, not only on the great economy of saving hospital expense by means of these supplies, but the great benefit in tropical climates from saving the men from the dangers of being on shore, by precluding them from the opportunities and temptations of intemperance, and from the exposure to the endemic and epidemic diseases of the climate.

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* There are striking examples of this in the journals of the Amelia and the Arab frigates, in the years 1804—1807.

The means proposed for the farther improvement of the health of the navy, are therefore the taking of measures for the prevention of pulmonic inflammation, farther attention to ventilation, cleanliness, and temperance, the hindering of men from going on shore in the West-Indies, and the providing of a better diet for the sick and convalescent. Other minor particulars might be enumerated, such as the baking of soft bread on board of ships, which is quite practicable,† and besides the superior salubrity of it over biscuit, the more commodious stowage of flour is a great recommendation.

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* The method is as follows; The meat is put into a pot, the bones being first removed, to be boiled in the ordinary way. When it is about three-fourths boiled, it is taken out and put into jars, which are filled up with broth made from other portions of the same meat. The jars are then corked, luted, and put into bags; they are next placed in a boiler of cold water, heat is applied till the water boils, and the boiling temperature is kept up for an hour; the fire is then extinguished, the water drawn off from the boiler, and the bottles or jars taken out, which completes the process.

† See Diseases of Seamen, pp. 138 and 284. Third Ed. The late

Whatever has been said with respect to the health of the navy, will apply to ships employed in commerce, but not in the same degree ; for in order to man the guns on board of a ship of war, there are three times as many men, including marines, as would be required merely for the purpose of navigating. Trading vessels therefore are not equally liable to the bad effects of crowding. Next to the Royal navy, the Marine of the East-India Company merits attention as a great public concern. The Directors of that Company very liberally permitted me to examine their medical records. It appears that there was an allowance of lemon juice in the service, long before it was supplied to the King's ships ; but the author was informed by the late Dr. John Hunter, physician to the East-India Company, that the supply was neither sufficiently ample nor good in quality. Since the practical proofs of its utility in the Royal Navy have become manifest, an adequate stock of good lemon juice has been supplied for the use of the mariners of the East-India ships, and of the troops conveyed in them, and with the same salutary effects. These ships not being so full of men as ships of war, fevers are not so apt to arise ; and there being no crowded transports nor slave ships belonging to this service, it is from these circumstances that we can partly account for our Eastern Settlements not being subject to malignant fevers like the Western : I say partly, for with respect to endemial diseases, there are tendencies of particular spots and regions of the earth to particular disorders, which are quite inexplicable in our present state of knowledge. For instance, none of the ports of the Bay

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Admiral Sir Benjamin Caldwell, G. C. B. and the Hon. Admiral Sir Alexander Cochrane, G. C B. informed me, that when they wer captains of line-of-battle ships, they found no difficulty in the baking of soft-bread for their ships' companies of Bengal are so subject to malignant fevers as the West-India harbours, though the creeks adjoining to the Delta of the Ganges are apparently similar. Batavia is the only port in that quarter of the world which can be compared to the Antilles in this respect. The swelled leg of Barbadoes and Cochin, and the *goitres* of certain mountainous districts, may serve as farther examples of the like local and unaccountable peculiarities. Dysentery and liver complaints, by a like peculiarity, are by far the most frequent and fatal disorders among seamen in India. The dysentery is probably owing to the vitiated and acrimonious secretions of the liver; this organ being much more liable to disease in India, at sea as well as at land, than on the Charibean stations. It is remarked in one of their surgeons' journals, that upon inspecting the body of some of those who had died of dysentery, he found abscesses in the livers of most of them. Early bleeding, when the strength will bear it, a free use of calomel, and purging salts, and the discreet use of opium, were found the most efficacious remedies. It is a great advantage in this service, that the military forces are not conveyed in crowded transports, as on the expeditions to the West-Indies. The soldiers are very judiciously distributed in small detachments in the India ships, and it does not appear that on any occasion the deleterious poison of typhous fever has ever been generated in the aggravated degree in which it has appeared in other quarters of the world; and this is no doubt one reason why the several presidencies of India have not been visited with the same dreadful scourge as our West-India settlements; though the atmospheric heat is considerably more intense in the former, particularly in the presidency of Madras.

It is therefore highly satisfactory to contemplate the many proofs of substantial benefits that have accrued to the sea service in the last forty years, both in war and commerce, in all quarters of the world, from the zeal, humanity, and good judgment displayed in promoting the health of seamen. It has been proved that it has added at least one third to the national force, and therefore subtracted in the same proportion from the national expenditure. It may be alleged by those who are disposed to question this position, that it is not by the improvement of health alone that ships are enabled to keep the sea at all seasons, and in all climates for an indefinite length of time. This is certainly true, for the sheathing with copper, besides adding to the speed of ships, has proved of incalculable benefit by superseding the necessity of frequent repairs, whereby much time used to be wasted in harbours.* It may farther be alleged, that by means of the recent discoveries in astronomy and mechanics, ships are enabled to keep the sea in prosecution of long cruises and voyages, whether for the purpose of war, commerce, or geographical science, without losing time and incurring danger by making land for the purpose of correcting longitude. All this is admitted. But these considerations are so far from disparaging the benefits of health, that they give it additional importance; for it is manifest that without the supply of lemon juice, and the other means of maintaining health for a sufficient length of time, the advantages of copper sheathing, the facilities in finding the longitude by chronometers, telescopes and astronomical tables, which do so much honour to the human intellect, particularly to the age and country in which we live, would be in a great measure frustrated. It would be of little avail that the depths of mathematical science, the elaborate researches of mechanical, optical and chemical* philosophy, should be called to the aid of navigation, so as to co-operate so admirably in carrying it to its present exalted state of perfection, unless the means of preserving health were to keep pace with these mighty improvements. And on a review of this subject in all its extent and relations, it will appear that there is not probably to be found in the whole range of human affairs, a finer illustration of the practical benefits of progressive knowledge in promoting the great interests of mankind: so that science, while it lends an aid, also sheds a grace and dignity over the useful arts: nor can there be a more striking proof of the maxim, that humanity, like every other moral virtue, is the best policy: nor could we light on a more happy example to elucidate that subsidiary influence and mutual dependence, by which all the arts, sciences, and professions have a reciprocal bearing on each other, conspiring to bring about the greatest sum of human enjoyment, and affording a field of contemplation, in which cultivated, benevolent and pious minds delight to expatiate.

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* The following is the history of the coppering of the navy, as furnished to me from the records of the Navy Office by the kindness of Sir Robert Seppings. The first ship that underwent this operation was a frigate in the year 1761, another in 1765, another in 1770, four in 1776, nine in 1777. The first ship of the line which underwent it was the Invincible, in March 1779, and seventeen more in the course of the same year. In the course of the two following years the whole British navy was coppered, a circumstance so important, that it may be considered as an era in the naval annals of the country.

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* See subjoined Illustration IX.

TABLE I.

Abstract of the Number of Seamen and Marines voted by Parliament for the Services of the Years 1779, 1782, 1794, 1804 and 1813 respectively, shewing the Numbers sent Sick to Hospitals, and Discharged therefrom, with the Numbers who Died therein in each respective Year, on the different Stations at Home and Abroad.

		Sent Sick.	Discharged.	Dead.	Run.
In 1779, 70,000 men voted.					
Home Station.	Haslar	15141	11712	807	523
	Plymouth	6799	5736	174	96
	Small Ports	2286	4333	183	149
West-Indies		3846	2425	467	221
East-Indies		....	......	....	..
Mediterranean		520	420	27	8
		28592	24626	1658	997
Proportion to the Number voted		1 in 2.45		1 in 42	
Proportion to the Sick				1 in 17	
In 1782, 100,000 men voted.					
Home Station.	Haslar	9103	7054	513	122
	Plymouth	4784	3813	136	21
	Small Ports	9022	9974	447	483
West-Indies		5104	3502	753	342
East-Indies		2810	1251	337	21
Mediterranean		794	696	36	4
		31617	26290	2222	993
Proportion to the Number voted		1 in 3.2		1 in 45	
Proportion to the Sick				1 in 14.25	

		Sent Sick.	Discharged.	Dead.	Run.
In 1794, 85,000 Men voted.					
Home Station.	Haslar........	8949	7206	496	226
	Plymouth.....	4237	3790	164	17
	Small Ports...	6062	7360	162	257
West-Indies...................		733	525	58	32
East-Indies..................		254	165	13	8
Mediterranean...............		1138	857	97	23
		21373	19903	990	563
Proportion to the Number voted		1 in 4		1 in 86	
Proportion to the Sick.........				1 in 21.6	
In 1804, 100,000 Men voted.					
Home Station.	Haslar.......	1667	1251	140	2
	Plymouth....	3888	3205	282	15
	Small Ports..	2095	2187	203	28
West-Indies.................		3215	2095	825	149
East-Indies..................		932	592	105	17
Mediterranean..............		181	118	51	3
		11978	9448	1606	214
Proportion to the Number voted		1 in 8.33		1 in 62.25	
Proportion to the Sick				1 in 7.5	
In 1813, 140,000 Men voted.					
Home Station.	Haslar.......	3592	3014	212	1
	Plymouth....	3563	2948	231	3
	Small Ports..	2578	1868	243	3
West-Indies.................		2392	2212	179	6
East-Indies..................		462	392	72	
Mediterranean...............		484	478	40	
		13071	10912	977	13
Proportion to the Number voted		1 in 10.75		1 in 143	
Proportion to the Sick				1 in 13.33	

TABLE II.

Shewing the Number of Seamen and Marines, annually voted by Parliament, for two distinct and equal Portions of War, with the Number annually sent Sick on Shore, and to Hospital Ships on the Home Stations, during those Periods.

Years.	Number of Men.	
	Voted by Parliament.	Sent Sick.
1778	[*] 60,000	15,978
1779	70,000	24,226
1780	85,000	32,121
1781	90,000	23,812
1782	100,000	22,909
1783	110,000	13,577
1793	45,000	17,280
1794	85,000	19,248
1795	100,000	20,579
	745,000	189,730
1796	110,000	16,860
1797	120,000	20,544
1798	120,000	15,713
1799	120,000	14,608
1800	111,538	17,747
1801	131,538	15,082
1804	100,000	7,650
1805	120,000	8,083
1806	[†] 120,000	7,662
	1,053,076	123,949

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[*] It may be remarked with regard to this and the preceding table, that the numbers voted being somewhat greater than the number actually employed, the inferences are not accurate. But these statements being comparative, the justness of the inferences will depend on the relative, and not the absolute number. Whoever wishes greater precision, may learn what abatement should be made from the number voted, by inspecting the statement in page 2, from which it appears that it is about one forty-seventh part.

[†] See Illustration I.

TABLE III.

Diseases, Wounds, and Accidents, admitted into the Royal Hospital at Haslar, in 1780.

Under the Physician's Care.	
Continued Fevers	5539
Intermittent Fevers	33
Small-pox	42
Measles	28
Anginæ	3
Pleurisy and Peripneumony	13
Asthma	61
Cough, Pain of Side, and Hæmoptoe	40
Consumption	218
Rheumatism	327
Lumbago	4
Palsy	9
Epilepsy	19
Jaundice	1
Dropsy	24
Scurvy	1457
Scrophula	4
Mania	16
Headach and Vertigo	3
Disorders of the Eyes	2
——— of the Ears	5
——— of the Abdominal Viscera	3
Cholic	1
Flux	240
Disorders of the Bladder	16
Gravel	32
Hæmorrhoids	2
Epistaxis	1
Total Physical Cases	8143

Under the Surgeon's Care.	
Cutaneous Disorders	165
Venereal Disease	183
Ulcers, including Wounds and Abscesses	979
Fistula in Ano	8
Fistula in Perinæo	12
Burns	4
Ruptures	3
Disorders of the Testicles	16
Contusions and Injuries of the Head	31
Contusions of the Trunk and Limbs	102
Œdema of the Leg or Arm	4
Luxations	8
Fractures	60
Erysipelas	12
Opthalmia and Disorders of the Eyes	17
Affections of the Urinary Organs	8
Amputations and Sundry Cases of Lameness	32
Total Surgical Cases	1644

In 1780 Physical Cases	8143
——— Surgical Cases	1644
Total	9787

Mem. The gross number of admissions this year, as appears by Dr. Lind's Letter subjoined, was 11732, of whom 909 died; that is 1 in 13. The classification above, therefore, does not exhaust the whole, which is not to be wondered at, when we consider the unexampled pressure of service, the ambiguity of cases, and the numbers accommodated in garrets, and under tents.

TABLE IV.

A Statement of the Diseases and Number of Patients admitted into the Royal Naval Hospital at Plymouth, under the Care of one of the Physicians on that Establishment, in the Years 1806, 1807, 1808, and 1809; together with the Number of Deaths in each Year, during that Period.

DISEASE.	1806.		1807.		1808.		1809.	
	Rec^{d}	Died.	Rec^{d}	Died.	Rec^{d}	Died.	Rec^{d}	Died.
Fever..............	180	37	72	14	76	16	219	22
Pneumonia.........	39	15	73	14	76	46	58	5
Asthma............	7	..	10	1	20	1	9	
Catarrh...........	33	..	12	1	5	..	12	
Phthisis...........	94	27	57	33	83	25	74	32
Rheumatism.......	59	2	39	1	50	1	47	1
Vertigo...........	2	..	1	..	2	..	2	
Epilepsy..........	15	..	3	..	13	..	3	
Mental Derangement	23	..	15	..	16	..	7	
Apoplexy.........	2	1	1	..	..	..	1	1
Phrenitis..........	..	..	..	..	..	..	1	1
Paralysis..........	5	2	2	..	7	..	10	
Diarrhœa.........	8	1	6	1	12	3	9	
Dysentery.........	15	4	12	2	13	4	43	11
Hepatitis..........	10	2	11	1	17	..	12	1
Icterus............	2	1	4	1	1	..	3	
Enteritis..........	1	..	2	..	1			
Gastritis..........	..	..	1	..	1			
Cystitis...........	:	..	1	.:	1			
Peritonitis.........	..	..	2	..	1	..	1	
Nephritis..........	..	..	..	..	1	..	1	
Dyspepsia.........	3	..	5	..	9	..	4	
Dropsy............	9	2	8	3	9	4	15	5
Debility..........	34	3	19	1	34	6	20	4
Gout..............	4	..	..	..	1			
	545	97	356	73	449	106	551	83

DISEASE.	1806.		1807.		1808.		1809.	
	Rec^d	Died.	Rec^d	Died.	Rec^d	Died.	Rec^d	Died.
Brought forward..	545	97	356	73	449	106	551	83
Hæmorrhois.......	2	..	1	..	1	..	1	
Lepra.............	2	..	1	..	1	..	1	
Colica............	..	..	2	2	1	..	1	1
Tympanitis........	1	..	2	..	2	..	4	
Cynanche.........	..	..	2	..	2	..	4	
Scarlatina........	..	..	3	..	..	..	3	
Erysipelas.........	1	..	1	1	2	..	1	
Constipatio........	1	..	..	..	1	1		
Chorea............	..	..	1					
Cholera...........	..	..	2	..	1	..	1	1
Diseased Stomach ..	..	..	1					
Incontinence of Urine	1	..	1	..	1	..	3	
Cephalalgia........	1	..	1	..	1			
Scrofula	2	..	1	..	1			
Tetanus...........	1	..	..	..	1	1		
Hæmatemesis......	..	..	2	1				
Scurvy............	1	..	1	..				
Diseased Intestines..	1	..	2	1	1			
Hypochondria......	..	..	..	..	1	..	1	
Gravel............	1	..	..	..	.	..	1	
Worms	..	..	..	..	1	..	1	
Palpitatio Cordis...	1	..	1	..	1	..	1	
	561	97	381	78	468	108	574	85

TABLE V.

Abstract of Medical Reports for the Months of January, May, and October, 1808, and January, May, and October, 1814.

MONTHS		Royal Hospital at Haslar.						Royal Hospital at Plymouth.					
		Number now in the Hospital.	Received.	Discharged cured.	Died.	Invalided.		Number now in the Hospital.	Received.	Discharged cured.	Died.	In valided.	
						Harbour Duty.	Unserviceable.					Harbour Duty.	Unserviceable.
Fever.	Jan. 1808	25	25	15	4			9	14	7	2	1	
	May....	11	17	15	3			13	25	16	6	..	1
	October .	3	4	4	2			5	9	3	2		
	Jan. 1814	32	24	15	2			15	15	18	1		
	May....	43	51	22				70	74	19	3		
	October .	17	13	14				7	10	14	1		
Dysentery.	Jan. 1808	9	10	13	2			4	2	1			
	May....	4	6	1	1			..	1	1			
	October .	26	40	23	4			1	2	2			
	Jan. 1814	13	11	7	2			3	4	2			
	May....	4	5	2	2			2	2	1			
	October .	13	12	22	2			3	4	2			
Pulmonic Inflammation.	Jan. 1808	38	37	14	5	..	4	36	34	5	6	4	5
	May....	72	84	50	13	..	1	58	94	54	21		
	October .	25	28	23	3	..	5	2	2	2	5	..	1
	Jan. 1814	111	83	36	7	4	6	11	10	23	1		
	May....	83	77	68	7	..	8	17	21	8	2		
	October .	51	35	49	10	..		18	22	11	..		
Ulcers.	Jan. 1808	124	44	32	1	2	6	41	23	4	1	1	1
	May....	62	18	31		..	7	80	53	14		..	2
	October .	79	26	20	1	2	11	28	5	12	..	1	4
	Jan. 1814	68	29	18		..	5	51	19	17			
	May....	36	14	17		..	6	29	15	17	..	..	9
	October .	60	26	24				51	35	11	..	..	10
Wounds and Accidents,	Jan. 1808	21	14	4	..	1	6	22	16	7	1		
	May....	15	8	8	1	1	6	39	12	10	..	1	1
	October .	14	7	2	..	..	1	15	7	4	..	..	2
	Jan. 1814	29	11	6	2	..	7	56	21	7	1	..	7
	May....	32	23	16	..	..	8	64	53	11	1	..	50
	October .	57	33	20	1	..	1	29	21	9	2	..	17
Other Complaints.	Jan. 1808	99	49	33	3	2	7	141	72	34	2	5	8
	May....	81	62	27	6	3	15	163	116	49	7	1	24
	October .	92	60	24	5	..	6	99	59	52	3	9	16
	Jan. 1814	168	104	65	6	3	14	206	106	84	13	2	21
	May....	102	87	82	8	..	10	260	217	102	7	..	74
	October .	141	76	56	3	..	7	216	120	101	9	..	24

TABLE VI.

Account of the Lunatic Officers, Seamen, and Marines, sent to Hoxton House, and variously disposed of for the last Five Years of the late War.

Year.	Received.	Discharged cured.	Discharged to their friends and otherwise.	Discharged to Bethlem.	Died.	Remaining on the 31st of December each year.
1809	76	10	3	43	9	112
1810	81	15	1	38	20	118
1811	85	4	3	53	16	128
1812	90	10	....	39	18	144
1813	93	17	7	55	13	140*
Total	425	56	14	228	76	

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* Including the following officers, one captain, four lieutenants of the navy; three lieutenants of marines; one surgeon, one assistant surgeon, two carpenters, one gunner, one master's mate, one midshipman.

ILLUSTRATIONS.

I.—*Page* 40.

The gradual increase of the navy since the 16th century, may be learnt from historical records. It appears that in the reign of Queen Elizabeth, the navy, at the time of the Spanish armada, was manned by four thousand and eighty-eight mariners, six hundred and eighteen gunners, and one thousand five hundred and twenty-four soldiers, in all six thousand two hundred and thirty; not a twentieth part of the naval force at the end of the late war: that the number of seamen and marines in the year of the battle of La Hogue, 1692, was thirty thousand: that during the whole course of the first and second succession wars, (the former terminating in the peace of Utrecht, the latter in the peace of Aix-la-Chapelle,) it was forty thousand: that in the beginning of the seven years' war, it was fifty thousand, and rose to seventy thousand at the accession of his late Majesty; this increase having been made on occasion of the family compact of the House of Bourbon, and continued till the peace of 1763. The numbers in the American War, and the late war, have been stated in the preceding tables. The great superiority of the late naval force will appear in a still stronger light, when it is considered that from the new methods of preserving the health of men, and of equipping ships; two ships are now more than equivalent to three in former times in point of efficient service.

II.—*Page* 41.

Extract of a Letter from Dr. John Lind, *late Physician to Haslar Hospital.*

The annexed state of Haslar Hospital in the year 1780, will shew the diseases to which the Royal Navy on the first equipment of fleets was then liable; and by comparing it with any statements you may obtain of it in the last war, will enable you to appreciate the effects of the improvements which have been since introduced into the navy, in correcting disease. On the 26th of October, 1778, the fleet under Admiral Keppel came into port, and before the end of December, sent three thousand six hundred sick to Haslar. This hospital contained one thousand eight hundred beds, of which one-fourth (four hundred and eighty) were in garret wards, suited only for convalescents, and restricted to about one-third the cubic space allowed for ventilation to beds in the regular wards; to receive this number of patients three hundred additional beds were placed in the lobbies to the garret wards, and many other places not before destined for patients. From this you will be able to account for its appearing in your reports from the Transport Office, that the succeeding year 1779 commenced with two thousand two hundred and seventeen patients in the hospital. What, under the severe pressure of circumstances, was adopted as a temporary measure, was afterwards during the war acted upon as a permanent provision. In proportion as this receded from the regular establishment, the recoveries became fewer and more tedious. In 1779, on the return of the Channel Fleet, under Sir Charles Hardy, into port, it became sickly; two thousand five hundred were in the month of September received into hospitals from it, and above one thousand ill of fevers remained on board for want of room in the hospitals. On this occasion the prison hospital at Forton was added to the relief of Haslar, and accommodated more than two hundred patients; it continued in this employ till the succeeding autumn, when an influx of sick prisoners recalled it to its original destination. Within four months preceding the year, of whose diseases I am to state the account, six thousand and sixty-four sick had been sent to Haslar; and at the commencement of the year there were two thousand four hundred and forty-three patients in the hospitals. Early this year a convalescent ship, the Mars, in which the patients, for the sake of holding a greater number, lay in hammocks instead of cradles, was added to the hospital establishment; and I may state, next year another convalescent ship, the Lioness, was joined to this, the former holding four hundred, the latter two hundred men. Some relief, though comparatively but a small one, had been obtained from private quarters throughout these difficulties.

The preceding account gives the cases of patients received into the hospital during the third year of the war. Strong infection had continued during the former years on board the receiving ships, which affected the ships fitting out, and generally the fleets on coming from sea into port; and a fleet of unusual magnitude, to which, in common with every department at the port, the hospital was disproportionate, from the strength of the enemy's combined fleets rendering it imprudent to divide, had remained collected at Spithead during a great part of the winter. The effect of this extended through the five first months of this year, and there was not afterwards experienced during the war any such fatal sickness.

Five thousand five hundred and thirty-nine cases of fever were admitted this year, of which three thousand seven hundred and fifty-five, or above two-thirds, were admitted in the first five months. The proportion of deaths to the general admissions into the hospital, was during that period as one to eight; during the remaining seven months as one to nineteen. During the above five months also six hundred and ninety-seven died, being above two-thirds of the whole number of deaths (nine hundred and eighty-seven) which occurred that year in the hospital. Thirteen cases of pleurisy and peripneumony appear in the account; but during spring many others occurred combined with the prevailing fever.

One thousand four hundred and fifty-seven cases of scurvy are noted. This is the only instance that occurred of the Channel fleet being in any considerable degree affected with this disease. In August, after a ten weeks cruise in the Bay of Biscay, when the beer and all fresh provisions had been exhausted, Admiral Geary's fleet returned to Portsmouth with two thousand four hundred men ill of the scurvy. Many of these were cured without being sent to the hospital, of whom some were landed and lodged in tents, others were allowed to walk in the fields through the day and return at night to their ships. Some had died on board, and two or three died in landing. To others this disorder proved fatal only in one or two exhausted cases.

Two hundred and forty fluxes were admitted. They were chiefly of a chronic nature, and in patients returned from abroad.

The proportion of fevers admitted this year was less than it had been during the two former years, and therefore the proportion of other diseases increased; it amounted this year to little more than two-thirds of all the other physical cases, and the proportion of physical cases was nearly five-sixths of all the patients admitted.

Of one thousand six hundred and seventy-eight surgical cases admitted, nine hundred and seventy-nine, or much above one-half, had ulcers, including a few cases of wounds and abscess.

The gross number of admissions and deaths this year, as appearing by the agent's books, were admissions eleven thousand seven hundred and thirty-two, and deaths nine hundred and nine, being in the proportion of one death to thirteen admissions.

After this period the Channel fleet became more healthy, and Haslar was not so much exposed to fevers. The state of the war which had before always required it to winter in a body at Spithead, then admitted of it being separated during winter, and divided between Portsmouth and Plymouth.

Besides the sick here enumerated, many scorbutics were sent on shore from ships who were taken care of by their own people, and no account of them was taken at the hospital.

III.—*Pages* 5, 6, 10.

DEAR SIR, *London, the* 8*th of July,* 1815.

I discover by referring to the log-books of ships of the Channel fleet, under the command of the Earl of St. Vincent, that the fleet sailed from Torbay on the 27th of May, and returned to the same anchorage on the 26th of September 1800, when out of 24 sail of the line, frigates, fire-ships, &c., composing the number returned to that road-stead, we had occasion to send only sixteen patients to an hospital.

During the above cruise the fleet had not one *fresh beef* dinner, and so strictly was the station off Brest preserved, that out of a hundred and twenty-one days, one only passed without communicating with the advanced post lying in the outer road of Brest Harbour, and the commander-in-chief ascertaining the enemy's force and position. This was a mode of cruising until then unknown, and utterly unpractised on that coast, but was then of vital importance to this country, as the French army, under the command of General Augereau, was embarked on board the French fleet, and waiting an opportunity of eluding us, the destination supposed to be Ireland, that country being then in a state of great commotion. At the very beginning of the cruise, scurvy made its appearance, but by a timely supply of lemon juice was soon subdued. It was during this cruise that the commander-in-chief devoted himself most particularly to that system of improvement in the detail of the fleet, which has subsequently by its adoption diffused health through the British navy in all climates, viz. the establishment of a sick berth, the excellent arrangement in ships' store-rooms, by which ventilation is produced, cleanliness of men's persons, cleaning of decks remote from ventilation by dry rubbing, correcting damp and foul air by burning fires, introducing seamen's dress suitable to the climate, airing beds and bedding twice a week when the weather would admit of it, &c. &c.; and of such consequence was the latter practice considered by the commander-in-chief, that he required a regular insertion of it in the ship's log, so that any deviation from this order in detached ships was liable to detection on rejoining the fleet. The introduction of these most salutary regulations so *entirely* belong to the Earl of St. Vincent, that hundreds of officers of the first character can attest, and the impartial historian record the same. No longer do we hear of ship fever laying up ships of the line, and their services lost to the country for many months at a time.

I am, dear Sir,
very faithfully yours,
A. BAIRD.

IV.—*Page* 5.

The abuse of words has been truly stated by philosophers as one of the chief means of impeding the improvement and retarding the progress of useful knowledge. This cannot be better illustrated than by the perverted application of the term *scurvy*. Eugalenus, a Dutch physician, in the beginning of the seventeenth century, laboured to prove that the scurvy properly so called, almost all the forms of cutaneous complaints, hypochondria and various other maladies, ought to be considered as one disease, and treated accordingly. As he wrote in a confident and dogmatic tone, in bold and specious language, he was followed by most of the eminent writers of the seventeenth and beginning of the eighteenth century, particularly Boerhaave and Willis, whose works abound with the most puerile and absurd conceits on this subject. There would have been little harm in this folly, had they not built upon it a most incongruous and pernicious system of practice.* Kramer, who was physician to the Imperial armies in Hungary from 1720 to 1730, relates that of four hundred men labouring under genuine scurvy, treated by one of the medical officers with mercury, so as to excite salivation, in conformity to the doctrines of his master Boerhaave, not one survived. This, though deeply mortifying to medical systems, is highly instructive, as an exhortation to study the rules of legitimate reasoning, the habit of discrimination, and the definite use of terms, while it ought to serve as a warning against the danger of idle speculations, gratuitous assumptions and perverted language, so abhorrent to the simplicity and modesty of truth and nature. And has it not been chiefly owing to the attention being engrossed by scholastic sophistry and jargon, that the world was deprived for near two centuries of the practical benefits of the citric acid in scurvy? This discovery, the legitimate offspring of experience and observation, was overlaid as it were, and nearly stifled by that spurious mass of presumptuous error and systematic dullness, which constituted so large a proportion of what was miscalled Medical Science, in the 17th and great part of the 18th century.

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* The following sentiment of Dr. Lind on this subject is as well conceived as happily expressed. "There would indeed be some difficulty in conceiving how men of such wild fancies as were they who have been deemed the principal authors on the scurvy, and to whom we are indebted for this general name, should get into possession of that degree of fame which they have acquired, did we not perceive how much the world is disposed to admire whatever surprises; as if we were endowed with faculties to see through ordinary follies, while great absurdities strike us with an astonishment which overwhelms the powers of reason, and makes inprobability even an additional motive to belief." It would appear that there are medical, as well as religious heresies and superstitions. This passage from Dr. Lind, relating to some of the fathers of modern physic, must remind every general reader of a parallel passage in one of the ancient fathers of the church.—*Credo quia absurdum—credo quia impossibile!*

V.—*Page* 5.

As a proof how much and how long this useful discovery was overlooked, it may be mentioned, that in the year 1753, a Fellow of the College of Physicians, and an eminent practitioner of that day, published a tract on the Sea Scurvy, in which he never adverts to the superior virtue of this medicine; and when the College was consulted on this subject by the government, they recommended chiefly vinegar, (see Mead's Works) which has been found by modern experience to possess but little power over this disease. Mead approves of this answer, and recommends also elixir of vitriol, which was supplied gratuitously to navy surgeons for many years. But though this mineral acid seems to palliate some of the symptoms, such as the hemorrhages, it has been found of no real efficacy in effecting a cure. The same author quotes a striking instance of the efficacy of lemon juice, but evidently held it to be inferior to other acids. The very able and accomplished compiler of Anson's Voyage says, "The cure seems impossible by any remedy or by any management that can be employed." Dr. Gallesio of Savona, in an elaborate treatise on the *Genus Citrus*, published in the year 1813, takes no notice of this most interesting property of the citric acid: and it may be mentioned, as a still farther proof of the neglect of this knowledge on the continent of Europe, that Captain Flinders, in the *Narrative of his Voyage of Discovery, published in 1814, relates, that when he arrived at one of the most remote points of his destination, his men were all in high health and strength, and with the fresh looks which they brought from Europe, by means of the ample supply of antiscorbutics, with which they were furnished when they left England in 1802; whereas the crew of a † French ship on the like service, was much affected with the scurvy. It is also matter of some wonder, that Captain Cooke's ship in the voyage of discovery to the southern hemisphere, in the years 1773 and 1774, was not furnished with this article; for the rob of lemons and oranges with which he was supplied, has not been found to possess the same virtue as the juice. The chief causes to which he ascribed the great health of his men in that voyage, and which are so eloquently commented on by Sir John Pringle (see Phil. Trans. 1776), were the use of malt, sour krout, and portable soup, together with extraordinary attention to cleanliness and ventilation. It may here be alleged that the scurvy was in this instance prevented without the use of this vaunted specific. But it appears from the narrative, that Captain Cooke was only fifteen weeks and three days on his longest cruise in search of a southern continent, which is not a sufficient time to prove thoroughly the efficacy of his methods, and far short of the time for which ships have kept the sea exempt from this disease, by the virtue of lemon juice alone, under circumstances in which all other means had failed.

We have in the history of this remedy a striking example of the difficulties and delays which obstruct and retard the progress and adoption of practical truths.‡ In addition

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* Vol. I. p. 226.

† The Geographe, Captain Baudin, Vol. I. p. 164, of this Voyage, drawn up by M. Peron, the naturalist.

‡ Among other instances that might be quoted of the neglect and

to what has been already stated, it may be mentioned that, in the year 1600, Commodore Lancaster sailed from England, on the 2d of April, with three other ships. They arrived in Saldanha Bay on the 1st of August; the Commodore's crew being in perfect health, from the administration of three table-spoonfuls of lemon juice every morning to each of his men; whereas the other ships were so sickly that they were unmanageable for want of hands, and the commander was obliged to send men on board to take in their sails, and hoist out their boats. Purchas's Pilgrim, Vol. I. p. 149.

VI.—*Page* 23.

No stronger proof of British humanity and attention to medical police can be adduced, than the state of health of the prisoners of war of late years. In former wars, fevers of the most malignant description used to break out in their places of confinement. Some complaints having been made of the pretended ill treatment and bad state of the prisoners of war at Dartmoor in the year 1811, an investigation was

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oblivion, and of the future revival, of useful medicines, one of the most striking in the history of physic is that of the remedy for the gout, which within these few years has acquired considerable celebrity; and though it has been suspected of not answering to its original character, is now regaining the public confidence. Alexander Trallian, a medical writer of Asia Minor, in the fourth century, ascribes to the Hermodactyl the same virtues as belong to the secret medicine above alluded to, known by the name of *Eau Medicinale de Husson*. It is sufficiently ascertained that the Hermodactyl is the root of the same plant as the *Colchicum Autumnale* of modern botanists; and it is also ascertained that it is to this last that the medicine in question owes its virtue.

The author is indebted to Sir Joseph Banks, P. R. S for the knowlege of these particulars: and Sir Joseph allows him to say that he is satisfied with the accuracy of the preceding statement, and also that he has experienced in his own person, all the beneficial effects that have ever been ascribed to this medicine.

instituted by public authority, from which it appeared not only that these complaints were groundless, but that these unfortunate men were treated with the utmost care, and that of six thousand five hundred and seventy-two, the number of which they consisted, only thirty-six were in the hospital, and only one had died the preceding week. It appears farther by the weekly returns made to the Admiralty, that in the course of the year 1813, the average number of French prisoners in Great Britain was sixty-four thousand six hundred and ninety-two. This was exclusive of Danish and American prisoners, and of those in foreign parts. The total number of deaths of French prisoners in all the *depôts* and hospital ships in Great Britain, amounted in the same year to one thousand one hundred and fifty-four, as appears by the same return, making one in fifty-five, as stated in the text. The following circumstances, which are entirely unconnected with their treatment, tended greatly to augment the mortality. 1st, The want of exercise, and that depression of spirits which is inseparable from a state of captivity. 2ndly, The extreme profligacy of many of the prisoners, some of whom were so addicted to gaming, that they staked and lost their clothes, and even the articles of their subsistence. 3dly, The returns included the deaths of prisoners who had been reduced to the last extremity after a sea voyage, during which they laboured under sickness and wounds, particularly those from Spain, towards the end of this year, after the siege of St. Sebastian's and the battles of the Pyrenees. It is evident that these casualties belong to the calamities inseparable from war, and have no relation to the treatment of the resident prisoners. It is equally evident, that the latter owed their extraordinary degree of health, to the clean and airy habitations, the wholesome and abundant food, the comfortable clothing and good medical treatment with which they were supplied by the British government: and it is a matter of public expediency and of justice to the national character, that these facts thus authenticated, should be proclaimed to the world as an answer to the calumnies that have been propagated on this subject—as an appeal to the candour of the enemy—and as a claim on his humanity and gratitude in the event of future wars.—This claim is farther enhanced by the remission in the late treaty of peace, of a large balance due by the French government for the maintenance of their prisoners.

VII.—*Page* 27.

While the author was a commissioner of sick and wounded seamen, ten recovered men were one day sent from Hoxton to be inspected. Upon questioning them it was found that in four of them the insanity had been occasioned by injuries of the head, of whom three had received these injuries while they were in a state of intoxication.

All the cases of lunacy which occur in the navy, are sent for cure and custody to an institution for the general reception of maniacs, situated at Hoxton, in the immediate vicinity of London. From thence such cases as are deemed likely to receive benefit from the treatment at Bethlem hospital, are removed thither, and if they do not recover in a year they are sent back, unless they are dangerous; in which case they are retained. Table VI. presents a view of this branch of the service for the last five years of the late war, as extracted from the records of the Transport Office. By adding to the sum of the number recovered during that space of time, the number remaining on the 31st of December 1808, which appears to have been ninety-nine, and dividing the total by the number of deaths, the mortality is found to have been one in 6.8. By documents called for by a Committee of the House of Commons appointed to investigate the state of the madhouses throughout the kingdom, it appears, that the mortality calculated in like manner for Bethlem hospital, was one in eleven, and for St. Luke's, one in sixteen. At the best regulated hospitals, such as the Retreat at York, the mortality is still less. This high rate of mortality at Hoxton, is an additional presumption in proof of that mismanagement in the institution, which was too apparent from the parliamentary investigation. There were indeed detected in the course of that investigation such scenes of horror in the general treatment of maniacs, as were disgraceful to human nature, and led to such enactments as have greatly ameliorated the condition of this unfortunate class of beings.

On comparing the number of lunatics entertained at Hoxton, as stated in the Table, with the number of seamen and marines in Tables I. and II., and supposing the whole maniacs of the navy to be assembled there and at Bethlem, it appears that the number remaining being 140, and the number of seamen and marines voted being 140,000, there is about one in a thousand in that unfortunate situation; and considering the great length of the war, this may be considered as the whole number belonging to this portion of the community. There are no doubt some maniacs belonging to the ships of war on foreign stations, but their number must be inconsiderable, for they are as soon as possible sent home as invalids, and lodged at Hoxton. It appears from all the statements regarding maniacs in general, that there are little hopes of cure, unless it is effected in the first year after the first seizure. It has been judged advisable by the author to record these facts as matter of future comparison, also as the means and motives of future improvement.

VIII.—*Page* 31.

The beneficial effects of the ventilation of transports cannot be better evinced than by the following example. In consequence of the very great mortality of convicts on their passage to Botany Bay in hired transports, in which no attention had been paid to counteract the causes of infectious disorders, a large ship named the Glatton, about equal in tonnage to a sixty-four gun-ship, originally intended for the East-India trade, which had been purchased by government to serve as a ship of war, was, soon after the peace of Amiens, destined to transport the felons. While she was under repair, Lord Chichester, the Secretary of State for the Home Department, sent Count Rumford, Mr. Graham a police magistrate, and the writer of this, to Chatham in order to give directions for fitting up that ship, so as to ensure proper ventilation. The means we recommended were the air-tubes already described, passing from the places where the convicts were to sleep, along the side of the ship to the open air; a narrow opening amidships, the whole length of the upper deck, protected by a covering in form of a pent-house a few inches above it, to prevent rain or other things from falling into it, and scuttles in the side to open and shut according to the state of the weather. By the help of these contrivances, together with due attention to cleanliness and diet, and by not being overcrowded, the voyage was performed without either fever, flux, or scurvy arising, and without any loss of lives, except five male and two female convicts from chronic disorders. The convicts consisted of 269 males, and 131 females, besides 31 women and children. She sailed from Portsmouth on the 23d of September 1802, and passed the same port on the 22d September 1803, in proceeding up Channel to the Downs, having returned by Cape Horn, and having made the voyage of circumnavigation in three hundred and sixty-four days, of which she was only two hundred and seventy-seven at sea, having been at anchor six days at Madeira, fourteen at Rio Janeiro, and sixty-seven at Botany Bay. The longest time which she was at sea on the outward passage, was eighty-eight days, having sailed from Rio Janeiro on the 14th of December, and arrived at New South Wales on the 12th of March. She sailed from thence on the 22d of May, and touched at no port till she arrived in England; so that she was seventeen weeks and five days at sea. The complement of men with which she sailed from England, was one hundred and seventy, not one of whom died on the whole voyage. Let this detail serve as a record of the perfection to which navigation as well as preventive medicine had attained in the beginning of the nineteenth century.*

IX.—*Page* 37.

The chemical preparations more particularly alluded to here are the composition-metal, as it is called, employed for hanging the rudder, and for fastening the sheets of copper to the ship, being adapted for these purposes by its peculiar property of not being corrroded by this metal: the preparation of metals adapted by their different degrees of expansibility in different degrees of temperature, to the delicate adjustments of chronometrical mechanism: also the different sorts of glass, which by their respective habitudes to transmitted light, correct the confusion and error produced by refraction in the lenses of telescopes. This is an improvement which Sir Isaac Newton at one time expressed a despair of ever being attained.† And we have seen a similar despair with regard to the cure of scurvy, expressed in a passage already* quoted from the Narrative of Anson's Voyage, reputed and believed to have been written by Mr. Robins, one of the ablest mathematicians and best writers of the last century. Mr. Robins, therefore, pronounces scurvy to be an *immedicable* disease. It would not perhaps have been thought too presumptuous if any one in like manner had predicted twenty years ago that the discovery of a safe, certain, easy, and speedy method of eradicating the small-pox, was beyond the reach of human sagacity, which has however been since realized. When we perceive therefore that certain useful and important discoveries and inventions have been made, some of them drawn from the deepest recesses of science, others found lurking under the very surface of nature, which the most profound and enlightened minds could beforehand hardly conceive, or believe to be possible, does it not afford a cheering and consolatory prospect, " amidst the thousand shocks that flesh is heir to," that there may still be in store for us, in the boundless progression and endless combinations of knowledge, other hidden means of advancing human happiness, of mitigating human misery, and of making accessions to the dominion of man over nature " which have not yet been dreamt of in our philosophy ?"†

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* In a correspondence on this subject in 1819 with Lord Sidmouth, then Secretary for the Home Department, his Lordship informed me that great benefit had arisen from the arrangements above-mentioned, and that they had been so much improved upon, that the mortality at sea had been reduced to 1 in 200 in the convicts transported to Botany Bay.

† See Newton's Opties, Book i. Part II. Prop. vii. and Vol. IV. page 68 of Horsley's edition of his works. Yet Newton afterwards (as if it had been pre-ordained, that this individual should, in every point of science which he touched upon, maintain his superiority over all the rest of the human species), in a letter to Mr. Oldenburg in the year 1672, (Horsley's ed. Vol. IV. page 322,) expresses some hopes of this object being attainable, and plainly hints at the princi-

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ple upon which Dollond, about eighty years afterwards, (see Phil. Trans. for 1759 and 1765) founded his invention of the achromatic telescope.

* See p. 53.

† The Marine Barometer might have been enumerated as another instance of the application of modern science to useful purposes, being an instrument, which, though not directly subservient to health, is occasionally the means of saving life, by giving notice of the approach of danger, and therefore, the mention of it is not here altogether out of place. A very recent instance of this occurred in the hurricane of the 9th of August 1814, the most violent that had been known on the Atlantic Ocean for many years. A fleet of merchant ships from the West-Indies, under convoy of the Warrior of seventy-

POSTSCRIPT.

After this Dissertation was put to press, the author found in the Journal Office of the House of Commons, and in the records of the Admiralty, certain documents which promised to throw light on the mortality in the navy in former wars. In the end of the year 1762, the House of Commons issued a precept requiring an account of the number of seamen and marines raised and lost in the preceding seven years' war. The return to this was, that one hundred and eighty-four thousand eight hundred and ninety-nine had been raised, and one hundred and thirty-three thousand seven hundred and eight had been lost, besides one thousand five hundred and twelve, who had been killed. The number under the head of *lost* has been considered as the amount of the deaths from disease, and this construction of it has been given out to the world;[*] but the author thinking this incredible, consulted the

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four guns, commanded by Captain Rodd, was exposed to its fury. In the course of a few hours before the gale came on, which it did with sudden violence, the quicksilver fell from 30.7 to 29.3 inches. The intelligent and vigilant commander, knew well how to avail himself of this alarming prognostic, by taking in sails, striking top-masts, securing the guns, and making signal to the ships in company to do the same. His own ship, and many others, were probably saved from foundering by this early precaution; but such was the violence of the storm, that several ships were lost notwithstanding this warning.

[*] The Medical Commissioner of the Transport Board, at the end of last war, in making a statement of its mortality in comparison of former wars, included in the first, but not in the last, all those discharged from hospitals as well as deserters, which gave a most fallacious result. This will be clearly perceived by comparing the *total* loss of men, as stated by Mr. Hutchinson in his ingenious paper on the Infrequency of Stone and Gravel among Seamen, as compared with the statement made in the second page of this Dissertation, which consisted of those lost by disease only.

records of the Navy Office, and found that all those men who had been sent to hospitals and never returned to their ships, all those who had been discharged as unserviceable, also all deserters were included. This gave no information therefore as to the degree of sickness and mortality. But the House of Commons having required an account of the number of *deaths* in the American war, the Navy Board returned an account of the dead and killed only, as in the annexed Table. It appears from this interesting document, that the total deaths in 1779 was five thousand two hundred and seventy-seven. The deaths at hospitals that year were one thousand six hundred and fifty-eight,* which leaves only three thousand six hundred and nineteen for the deaths on board of ships. This does not accord with the statements in pages 2 and 3, but as there was not time for all the ships to have returned from foreign service, and as the war was not then at an end, a complete account could not be taken of the deaths; and hence the qualifying clause in the title of the annexed Table, *as far as the accounts can be made up.*

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* See Table I.

Number of Seamen and Marines raised from the 29th of September, 1774, to the 29th of September, 1780, also the number who have died and who have been killed, from the 1st of January, 1776, to the 1st of January, 1781, as far as the accounts can be made up.

Dates.	Raised.	Dead.	Killed.	Total.
1774	345			
1775	4,735			
1776	21,565	1,679	105	1,784
1777	37,457	3,247	40	3,287
1778	41,847	4,801	254	5,055
1779	41,831	4,726	551	5,277
1780	28,210	4,092	293	4,385
Total	175,990	18,545	1,243	19,788

DISSERTATION II.

On the MEDICAL SERVICE *of the* FLEET *in the* WEST INDIES *in the Year* 1782.

As a supplement and further illustration of the general abstract of the Comparative Health of the Navy, which forms the subject of the preceding article, in order also to render the contrast of former times with the present more palpable, it may not be devoid of interest and utility to dwell at some length on the details of a portion of the service which fell under the author's own personal observation forty years ago.

In the course of the year 1780, my first year of service as physician to the fleet on the windward station, I found from my own returns, and from examining the records of the hospitals, that the loss of lives from disease had been at the rate of one in seven: nor was this alarming rate of mortality imputable to the prevalence of the peculiar epidemic of the climate, for there were very few cases of yellow fever; and as the principal causes of it were such as seemed to me to be removeable by practicable and attainable means, I was anxious to state these circumstances at the source of authority. I found, that in a fleet, of which the complement of men was 12109, the mortality in one year amounted to 1518, besides 350 rendered unserviceable, a number more than equal to the equipment of three ships of the line. When this is duly weighed by a considerate mind, as it affects the most important interests of the state, together with the great difficulty and expense of replacing these valuable subjects by fresh recruits, and when the calamitous sufferings of the individuals themselves are brought home to our feelings, no case could well be conceived more calculated to awaken sentiments of patriotism and humanity.

A favourable opportunity of making the requisite statement of this occurred when I attended the Admiral commanding in chief, Sir George Rodney, afterwards Lord Rodney, on his visit to England in the autumn of the year 1781.

In a memorial to the Board of Admiralty, I stated the causes of disease to consist in :—

1st. The neglect of cleanliness, ventilation, and dryness in the interior economy of ships.

2ndly. The want of a supply of an article, which had been found, by the most unequivocal experience to be infallible in preventing and curing scurvy, one of the most destructive scourges, and the most peculiar to the sea service, of any class of disease. The remedy alluded to is the juice of lemons or limes.

3rdly. The abuse of spirituous liquors, not merely as the most common means of intemperance, but as the habitual beverage of seamen, even when diluted. I recommended the substitution of wine, and, I ought to have added, of strong malt liquor.

4thly. The want of adequate nourishment and comfort for the use of the sick and convalescent on board of their own ships.

5thly. The want of proper bedding and of soap, so that along with the suitable articles of diet, the means might be afforded of curing men on board of their own ships, the hospitals on that station being at that time too small, ill arranged, and extremely expensive; the men by going ashore being also exposed to the epidemics of the climate, and to the most pernicious temptations, from the facility of procuring the means of intoxication.

6thly. The want of a gratuitous supply of medicines, as well as necessaries to the surgeons, in order to enable them to cure as many as possible without sending them to hospitals.

7thly. As Hospitals are, to a certain degree, indispensable at the principal stations, especially for the relief of ships in which contagious diseases prevail; new regulations in point of space, separation, ventilation, and cleanliness, were also recommended in them.

Though all the recommendations here specified were not at this time complied with in their full extent, enough was done to evince their expediency, and led to great future improvements. I had the immediate and high gratification of succeeding in the recommendation of wine, and of being an eye-witness of its almost incredible benefit in the new reinforcement which accompanied the Admiral on his return. The Formidable of 90 guns, the flag-ship, in which I was embarked, was, by way of experiment, supplied with Teneriffe wine of an excellent quality, to the total exclusion of spirits, besides melasses and sour krout. By virtue of this peculiar advantage, the men of this ship enjoyed a degree of health far superior to any other in the squadron; for of 750 men none died in the Formidable for four months after leaving England, nor were any in that time sent to the hospital, except thirteen, of whom none were affected with any of the diseases belonging to a life at sea, for they were all cases of small-pox, wounds, and ulcers. Nor did any real sickness break out in this ship, till the infection brought on board at Jamaica by the return of men lent to assist in cleansing the Ville de Paris in the months of June and July of that year. After this the whole fleet was supplied with wine.

Though partial supplies of the anti-scorbutic fruits were ordered on particular occasions, it was not till the year 1795 that the general supply of lemon juice was decided on by the Board of Admiralty. This happened a few months after I was appointed a commissioner of the Board for the care of sick and wounded seamen; but it is due to Dr. Blair, then Chairman of that Board, to mention, that he had stated the expediency of the measure some months before my appointment. All the other measures regarding medicines, necessaries, and bedding, were soon after duly attended to, except the supply of soap to men in health, which, by an unaccountable blindness in those who have conducted the civil affairs of the navy, has never been carried into effect.

Some very impressive examples of the speedy and complete cure of scurvy by the citric acid (the scientific term in chemistry for the juice of the fruits of the genus Citrus and natural order *Hesperidœi*) occurred on board of the Invincible and Alcide in the first year of my service, and next year on board of the Arrogant, and a still more striking and conclusive proof of this on a large scale occurred in the autumn of 1782, in a fleet of 28 ships of the line, at New York, as specified in my work on the Diseases of Seamen. In these the scurvy and scorbutic habit prevailed to a great degree; for though orders were given at Jamaica, where they lay for ten weeks previous to sailing for North America, for the purchase of fruit and other vegetables, very little could be procured, on account of the extraordinary drought of the season. Fortunately, a small prize vessel loaded with limes, lemons, and oranges, was carried into New York, about the time the fleet arrived, and the whole cargo was, by my advice, purchased for their use. In consequence of this and other refreshments served on board, few cases were sent to the hospital; and the men, as soon as they could walk, were sent on shore for a few hours every day for recreation, by which means their health, strength, and spirits, were restored in a few weeks.* I had also the great satisfaction at this time of having my recommendation for the supply of soap complied with, and of perceiving the vast utility of this temporary supply to the great number of men who were cured on board of their own ships.

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* It is not a little singular, and much to be regretted for his own sake, that the physician to the Mediterranean fleet in the beginning of the late war should have been so little acquainted with this, and many other similar facts in my own writings, and those of others in

It occurred to my mind, as a duty incumbent on me as physician to the fleet, soon after my arrival on the station early in 1780, to enlighten the commanding officers, as far as lay in my power, regarding the most effectual means of maintaining the health and vigour of the men, of preventing the invasion of disease, and of doing justice to the sick. I perceived indeed the most anxious and laudable pains taken to husband and preserve from decay all manner of stores, such as ropes, blocks, spars, gunpowder, and arms.

the course of the two preceding wars, as to have claimed, on the return of peace, great merit, and even solicited a reward, for having been the first who introduced the use of lemon juice into the navy. I believe the first ample supply of lemon juice to ships of war was as long ago as the year 1757, to the squadron under Admiral Watson, in the East-Indies, at the suggestion of his surgeon, Mr. Ives, a gentleman highly educated, of great merit and modesty; and we do not learn that he courted public notice, far less that he solicited a reward in doing what he deemed to be merely his duty: and it is no less unaccountable, that this physician to the Mediterranean fleet should have brought forward, as a testimony in his favour, on which he highly plumed himself, a certificate from the commander-in-chief on that station, stating, that in consequence of a supply of lemons, the fleet under his command had been freed from the scurvy in *six months.* It is ascertained by incontestable, long, and repeated experience, that the above-mentioned disease can be cured by the above-mentioned remedy, duly administered, in less than the same number of weeks. I should deem these particulars unworthy of notice, but I am compelled to mention them, not only as a matter of truth and justice due to the public, but as a matter of self-vindication, for the gentleman alluded to thought proper to arraign me in severe terms before the public, for omitting all mention of his name, and fancied merits, in my History of the Health of the Navy, published in 1815. The vehicle he chose for this abuse was a common newspaper, in which he not only published his own letters, but a private one of mine, without my knowledge or consent, and in opposition to a protest which I made against such an unbecoming channel of communication.

But however precious these may be, as the indispensable implements of war, it will not be disputed that human hands are at least equally so. Yet, though there was the additional motive of humanity, it does not appear that this branch of duty had been studied with the like degree of attention as that which regards the care of the inanimate material of war. It must also be obvious to naval officers, that it is on the numbers and vigour of the hands that their own success and reputation must depend in the conflict with the elements, and in the hour of battle. Money has metaphorically been called the sinews of war; but the most indispensable article for the efficient purposes of war, is the sinews literally, and properly so called, belonging to the living engines by whose energies it is carried on. This oversight is not imputable to the inhumanity of those who conduct the navy in the civil and military departments, but to that error of judgment, by which they conceive, that all that concerns the health of the men, lies in the department of the medical officers, and that if they take care to provide professional gentlemen, possessed of due skill, and furnished with an adequate assortment of drugs and instruments, they stand absolved from all further responsibility in what regards the health of the mariners.

I felt it therefore as a matter of imperious duty to explain myself fully on this subject to the commanding officers of the fleet. This I did in a printed tract, which was distributed among the flag officers and captains. In this I endeavoured to set forth how much the health of the men, particularly with regard to the prevention of disease, depended on the good judgment and exertion of officers, who alone could establish and enforce the regulations respecting ventilation, cleanliness, and discipline. This was extremely well received;* and it is not for me to say what share it may have had in the great alteration in the conduct of the officers of the navy regarding these duties, and how far it may have contributed to the revolution which has taken place in later times in the whole system of the medical management of the navy. There can indeed be no situation in which there is more room for genuine virtue, praiseworthy conduct and address;—none to which there attaches more grave and solemn responsibility; — none on which there is a more imperious claim on the conscientious discharge of duty, than that of a naval officer. The men are cast on his humanity and discerning judgment under various aspects. Seamen and marines are subjected by martial law to a more arbitrary exercise of power, than the constitution of the state authorises in civil life, or even in the army;* for Englishmen surrender to him from considerations of public expediency, what they hold most dear, and that of which they are most jealous, their liberty: — all seafaring people, especially those employed in war, are exposed to peculiar and unavoidable privations, hardships, and dangers, which ought to be mitigated, as far as is practicable, by those at whose absolute disposal they place their lives and limbs:—it is in their character to be unthinking and careless of their own welfare and interest, requiring to be tended like children, and, like children, are entitled to a *parental* tenderness from the country they protect and the officers they obey.

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* The author has in proof of this, not only the innumerable testimonies of personal regard which he has experienced during the after part of his life from these distinguished persons, but their interposition

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on his behalf on the conclusion of the war, when they unanimously made application, through the Admiralty, for a reward to him in peace, no half pay being then established for physicians to fleets. In compliance with this His Majesty was pleased to grant him a pension.

* Not to mention pressing an infringement on liberty, so adverse to the genius of English law, naval officers can at their single arbitrary discretion inflict summary and severe punishment, whereas no punishment can be inflicted in the army but through the solemnity of a court martial.

In further prosecution of this subject, the author will lay before the reader a detail of some of the occurrences of the splendid campaign of the year 1782, with some remarks on the importance and influence of the study of health, and an abstract of the total loss of men in the armaments to which he was attached.

Lord Rodney, from that thorough experience and comprehensive knowledge which might be expected in a commander who had borne an active part in three great wars, clearly perceiving that the chief theatre of naval warfare on which not only the sovereignty of the ocean, but the fate and character of the nation was to be decided, would be the Charibean seas, quitted his station at the commencement of the hurricane season, during which there used to be a suspension of military operations, in order to state and explain this, and to solicit adequate succours against the following campaign. This he did without the leave of the Government, trusting that he would be justified by the magnitude of the object and the purity of the motive. He was not only forgiven, but so liberally listened to, that a reinforcement of twelve ships of the line was immediately ordered to be equipped to accompany him on his return. On one of the first days of December he had a closet audience of the King on the subject of the ensuing service, in which His Majesty expressed great anxiety regarding the safety of the West-India islands, intelligence having just then arrived that the Comte de Grasse, after a drawn battle with the British fleet off the Chesapeak, and the surrender of the army under Lord Cornwallis, had sailed with his whole force to the windward station. Upon this Lord Rodney, with his characteristic warmth of patriotism and loyalty, said to His Majesty, that in place of waiting, as had been arranged, for the intended reinforcement, all the ships of which could not be ready for three weeks, he would leave town next day, and sail with whatever force he might find ready. He accordingly repaired to Portsmouth the following day, accompanied by his secretary and myself. Here he found only four ships in readiness, with which he sailed, and was to be joined by two more off Plymouth; but having met with contrary winds in the channel, he was forced into Torbay, where the fleet was wind-bound for three weeks, during which the other ships had completed their repairs, and a squadron of twelve sailed in the middle of January, 1782.

Soon after the arrival of this reinforcement the fleet was farther augmented by the arrival of five more ships of the line, so that the Admiral found himself in Gros-Islet Bay, St. Lucia, at the head of a line-of-battle of thirty-six ships, the greatest naval force that ever assembled in one spot either before or since on a foreign station. There were four ships of the line besides in the West-Indies then cruising or protecting convoys. Those included in the line-of-battle consisted of five of 90 guns, nineteen of 74, one of 70, eleven of 64, manned with 21608 seamen and marines.

It will be seen from the annexed Table what was their state of health on the 1st of April. In some of the ships there was not a man that could not come to his quarters. The most healthy were either those which had been seasoned to the climate, such as the Ajax, in which there was not a single sick man, or those which had recently arrived from England, such as the Formidable, in which there were only two on the sick list.

His Majesty's forebodings expressed at Lord Rodney's audience proved too true, for on the arrival of the Comte de Grasse on this station, his naval superiority was so great, that he had captured the island of St. Christopher, and some late reinforcements from Europe had swelled his force to an unparalleled amount, a fact which justified the Admiral's solicitude in repairing to England for reinforcements, and accounted for his anxious promptitude in returning to his station.

There lay ready for sea at Martinique at this crisis thirty-three ships of the line; one of 106 guns, two of 90, two of 84, two of 80, twenty of 74, one of 70, five of 64, besides one of 80 under repair. They had, according to the best intelligence, 5400 land troops on board.

On the morning of the 8th of April a signal was made through a chain of frigates stationed between St. Lucia and Martinique, that the enemy's fleet had unmoored, and were proceeding to sea. Upon this the British fleet, at that moment in complete readiness, took up their anchors, and in little more than two hours were all under way, standing towards the enemy with all the sail they could crowd. It was the decided policy of the French commander not, on any account, to hazard a battle, the sole object of the expedition being that of joining a large sea and land force of the Spaniards then waiting at Cape François, in order to proceed against Jamaica with their joint armament, amounting to the overwhelming force of near 50 ships of the line, and 20,000 land troops. This mighty and deep laid scheme, so hostile to the best interests of the British nation, could no otherwise be disconcerted, than by the discomfiture of the armament now rising into full view. In proportion to the momentousness of the object was the anxiety of our commander-in-chief to overtake and attack the enemies of his country, and there has seldom, I believe, occurred in the history of rival nations an occasion in which higher interests, or a deeper stake in point of honour was to be contended for, than what presented itself at this moment. We gained so much upon them, that next morning the van and centre of our fleet, including the flag-ship, had got within cannon shot of the enemy's rear, and a sharp cannonade ensued, which, however, proved partial and indecisive, from the falling of the wind, and from a great part of our fleet being becalmed under the high lands of Dominique. In the course of the two next days the enemy, by dint of great efforts, kept far to windward, and would probably have made their escape, had they not been brought down on the 11th, by a movement to save one of their ships which had dropped to leeward, in consequence of being crippled by running foul of another ship in the night. By this casualty we had the inexpressible pleasure at day-break on the 12th, to discover that we were in a situation to weather a large part of the enemy's fleet, which was now reduced to 30 ships, two having been so much damaged by the action of the 9th, that they could not resume their place in the line, and one having been rendered inefficient by the accident above-mentioned. The line-of-battle was formed in an incredibly short time, the officers of the fleet having acquired the utmost expertness in naval evolutions in the course of the last two years practice on this station. About half an hour before the engagement commenced, at breakfast on board of the Formidable, the company consisting of the Admiral, Sir Charles Douglas, captain of the fleet, (an officer, whose functions nearly correspond with those of the adjutant-general of an army,) Captain Simmons, commander of the ship, Lord Cranstoun, a volunteer post-captain, the Admiral's secretary, and myself, the conversation naturally turned on the glorious prospect of the day, and Lord Cranstoun remarked, that if our fleet should maintain its present relative position, steering the same course close-hauled on the opposite tack to the enemy, we must necessarily pass through their line in running along, and closing with it in action. The Admiral visibly caught the idea, and no doubt decided in his own mind at that moment to attempt a manœuvre hitherto unpractised in naval tactics. It was accordingly practised by him with the most complete success, setting the illustrious example in the ship which bore his own flag; for after about an hour and a quarter of close action, and after taking and returning the fire of sixteen ships, somewhat more than one-half of the French force, under one general blaze of flame and peal of thunder along both lines, the Formidable broke through that of the enemy. In the act of doing so, we passed within pistol shot of the Glorieux of 74 guns, which was so roughly handled, that being shorn of all her masts, bowsprit, and ensign-staff, but with the white flag nailed to the stump of one of the masts,* breathing defiance as it were in her last moments, became a motionless hulk, presenting a spectacle which struck our Admiral's fancy as not unlike the remains of a fallen hero; for, being an indefatigable reader of Homer, he exclaimed, that now was to be the contest for the body of Patroclus. But the contest was already at an end; for the enemy's fleet being separated fell into confusion, a total rout ensued, and victory was no longer doubtful.

It is natural at first sight to impute this success to the numerical superiority of six ships; but it was computed by Sir Charles Douglas (the most enlightened and scientific naval officer with whom I was ever acquainted,) that the sum total of the weight of a broadside of the French fleet exceeded that of the British fleet by 4396 pounds: and though the number of our guns exceeded that of their's by 156, their lower deck batteries, in ships of 74 guns and upwards, consist of 36 pounders, which, according to the difference of the pound of the two nations, are equal to our 42 pounders, and gave the enemy the above-mentioned preponderance of metal on the whole amount. The difference in the number of men was still more considerable; for besides that the French have a much greater complement of men to the same tonnage, they had the assistance of a large body of land forces.

The only cause therefore that can be assigned for British superiority in this and many other naval encounters, can be no other than the closeness of the action, an advantage, however, which being mutual and equal, can be available only to that party which possesses the moral pre-eminence of undaunted courage, and the consequent physicial superiority of a better sustained fire; and this was never more fully exemplified and proved than in the present instance. In breaking the line, the Formidable passed so near the Glorieux that I* could see the cannoniers throwing away their sponges and hand-spikes, in order to save themselves by running below, while our guns were served with the utmost animation. Another advantage of close fight is, that more of the shot tell in this situation, though they are much less destructive both to ships and men, unless, according to the recommendation of Robins, a smaller charge of powder should be used in close action. Distant shot, in consequence of their momentum being spent, make large chasms in a ship's side, shivering whole planks, and causing innumerable splinters, more destructive to men than the ball itself; whereas a close shot cuts so clear, that it makes an orifice even less than its own diameter, and without producing splinters. The average proportion of wounded to killed is about three to one; but this ratio will vary, according to the distance and the charge of powder.

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* This was no doubt the act of the French officers; for though we had proofs of the inferiority of their seamen to our's in point of bravery, the same cannot be said of their commanders, who are as high-minded men as any in the world. We found among the prisoners many persons of distinguished birth. The Glorieux was commanded by Viscomte D'Escars, of the House of Fitz-James, as remarkable for his intrepid courage, as for his rooted hatred to the English name and nation. On boarding her our officers found that he had been killed in the battle, and they were shewn the stains of blood on the gunnel where his body was thrown over-board. There were among the captive officers two of the celebrated family of St. Simon, the Viscomte de Betisy, and others.

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* Having but little knowledge, and no practice in surgery, and as there was the full complement of medical officers on board, I requested the Admiral's leave to absent myself from the quarters assigned me, and to remain with him on the quarter-deck during the action. It occurred to me also, that I might possibly be of some use in this spot in case of any severe injury threatening life from hæmorrhage, and for this purpose I carried some tourniquets about me of a simple construction; but no such accident occurred on the quarter-deck of the Formidable. Captain Bayne, of the Alfred, killed in the action of the 9th of April, was thought to have expired by a hæmorrhage from the leg, which took place while he was carried to the cockpit, so that the timely application of a tourniquet might have saved the valuable life of that excellent officer. The tourniquets alluded to, consisted merely of a piece of leather, somewhat stiff but flexible, about the breadth of the hand, and long enough to embrace the limb, with slits to admit a piece of broad tape; a piece of linen or calico rolled, so as to act as a compress to the artery, and a cylindrical piece of wood to twist the tape in the act of applying the instrument. Would it not be advisable at all times that some intelligent person, a warrant or petty officer, quartered on the quarter-deck, should carry in his pocket some such instrument, particularly in large ships, on account of the distance of the cock-pit? He need not be a medical officer; and the only instruction necessary would be to point out to him the situation of the great artery in the thigh and arm: or with this information alone, the blood might be stopped by a handkerchief tied tight.

As this part of the narrative appears at first sight to bear little or no relation to the subject of health and disease, does not the author run the risk of laying himself open to the censure incurred by that law of sound criticism, which adjudges it to be a violation of unity and good taste, thus to bring together subjects of an incongruous nature; for what two things can be so remote, nay, (it is to be hoped,) so opposite in their nature and scope, as war and physic? And does he not also expose himself to the charge of vain glory; for what motive, it may be said, could he have, but that of ostentation, for obtruding matters in this place which it was so much out of character for him to touch upon?—Be it so.—He would be guilty of gross affectation were he to deny, that though it would perhaps better become him, at this stage of his existence, and bending, as he now is, under the weight of years and affliction, to subdue and repress all such light-mindedness, he does nevertheless feel some degree of pride and satisfaction in looking back on that part of his life, in which it was his lot to witness, and to act a humble part in scenes of high moment and interest to the welfare of the state, and the character of the British arms. But he hopes to shew his reader, that there is perhaps more connection than he is immediately aware of, between those actual incidents of war which have been described, and the duties of medical officers: for, besides what has just been stated regarding the different effect of close and distant action on the number and nature of wounds, there are other particulars in which the casualties of battle are connected with the state of sickness and wounds.

1st. A great share of the extraordinary degree of health exhibited in the Table for the month of April, 1782, seems clearly imputable to the influence of success on the spirits of the men. It is related, that when the fleet under Admiral Matthews in the year 1744 was off Toulon, in the daily expectation of engaging the combined fleets of France and Spain, there was a general suspension of the progress of sickness, particularly of the scurvy, from the influence of that generous flow of spirits with which the prospect of battle inspires British seamen. But if the mere prospect and ardent expectation of battle, without any happy result, could have such a sensible effect, what must be the effect of the elevation of mind created by the exultation of VICTORY, a victory in which the naval glory of our country was revived and retrieved, after a series of misfortunes and disgraces, which had well nigh extinguished the national pride and spirit in every department of service. The plain and honest, though unthinking seaman, is not less affected by this, than the more enlightened lover of his country. Even the invalids at the hospital manifested their joy by hoisting shreds of coloured cloth on their crutches.* This is the place, therefore, to remark of what importance it is in point of health, to support the spirits of men, depression of mind not only damping their courage, but being favourable to the invasion of disease in every form. There is, perhaps, no disease which low spirits are so apt to produce as the sea scurvy. It is important, therefore, to encourage such innocent and salutary recreations, as music and dancing. It is a common, and I believe, a true remark, that the French have a great advantage over us in this respect, being by nature gifted with a constitutional gaiety. But even in them, this may be so far subdued by the depressing circumstances of captivity, as to create scurvy without the ordinary exciting causes of that disease, as was mentioned in the last Dissertation, at Portchester Castle and Norman Cross, under the use of fresh diet. It is further observed, that this nation bears adversity with more equanimity than the English. An eminent example of this occurred to my own observation in the case of the Comte de Grasse, commander-in-chief of the French fleet, who was taken prisoner in the Ville de Paris. When he was conveyed on board of the Formidable the morning after the battle, the first conversation was carried on with Lord Rodney, through Sir Charles Douglas; for our Admiral had never learned to speak French; but Sir Charles being much engaged in the duties of the fleet, beckoned to me to replace him as interpreter, introducing me to the Comte in the following facetious manner: *Permettez moi, mon Général, de vous présenter notre medecin en chef, qui est presque assez habile pour faire revivre les morts;* to which the Comte, humouring the *plaisanterie*, answered, *Et peut-être pour faire mourir les vivans.* It fell to my lot chiefly to entertain him during the rest of the day, and his conversation partook of the like affability and good humour.

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* Sir James Macgregor, Director General of the Medical Board of the Army, in his interesting work entitled Medical Sketches, adduces a like example of the happy effect of an exalted state of mind in sustaining hardship and fatigue in the army of India, while crossing the Desert in their route to Egypt in the year 1801. I have mentioned a like fact in the account of my mission to Walcheren in the year 1809, an account of which will form an article in this volume.

2dly. Another circumstance in which the detail of warlike operations affects the duties of the medical officers remains still to be mentioned. In some of the actions in the previous part of the war, a great proportion of the killed and wounded had their injuries inflicted by the accidental explosion of gunpowder, by cartridges catching fire, but still more from the powder used for priming, which, according to the custom then in use, was contained in large ox-horns. In one of the battles to windward of Martinique in the year 1780, out of 167 wounded, 46 were scorches from gunpowder, of which 14 proved fatal. The number of such casualties was greatly diminished in the late actions, in consequence chiefly of greater habits of caution acquired in the course of the war. This applied to the fleet in general; but these mischances were still better guarded against in the Formidable and Duke, both of 90 guns, by the use of small priming boxes of tin, as part of the apparatus belonging to locks, and no small additional recommendation to that method of firing guns. The service is indebted for this great improvement to Sir Charles Douglas, who first introduced it into the navy when he was captain of the Duke. The whole, or the greater number of the guns of this ship were furnished with locks, but only a few in the Formidable, and none in any of the other ships. Part of this method consisted in filling the touch-hole with powder contained in a quill,* which made no more priming powder necessary than what was contained in the small tin box. The eminent and ingenious contriver of this improvement suggested, that it was incumbent on me, as a point of professional duty, to represent these facts to the Board of Ordnance, as the means of saving men from dangerous and fatal injuries. This I accordingly did; and this consideration, in addition to the more obvious advantages in the quickness of firing, and the greater accuracy of direction, may have probably had some share in deciding the adoption of an improvement which has since become general in the navy.

Lastly. The only other remark to be made on this subject is, that it has been ascertained by long experience, that no refreshment but plain water, ought to be allowed to the men during action; and the expediency of it has been established by the immemorial usage and uniform practice of the British navy. It has been equally ascertained by experience, that in all violent and even protracted bodily exertions, whether from necessity or for wagers, as in long walks, it is found that strongly nutritious food and stimulant liquors, taken either immediately before, or during such trials of strength, do not sustain but impair the animal powers. This is particularly applicable to men in the heat of action. It would appear that there is something in situations of exertion and danger which infuses a sort of preternatural vigour far surpassing the effect of any corporeal stimulus. When the mind is interested and agitated by warm and generous affections, the body forgets its wants and feelings, and is capable of a degree of labour and exertion which it could not undergo in cold blood. The quantity of muscular action expended in fighting at a great gun for a single hour, is perhaps greater than what is employed for a whole day in ordinary labour; and though performed in the midst of heat and smoke, and with little bodily refreshment, yet the powers of nature are not exhausted or overstrained; even the smart of wounds is not felt: though pure cold water was the only refreshment allowed in time of action in the West Indies, it may be advisable in cold climates and seasons, to add a very small portion of spirits, the very idea of which would give the men more confidence in the efficacy of their beverage. Those who walk for wagers are said to indulge in a tea-spoonful of brandy in the small draughts of water which they take from time to time. On this subject it is an instructive remark, well ascertained by experience, that after excessive fatigue, the strength is best and most safely recruited by a slender meal. I have known dangerous fevers brought on, by full meals of animal food and fermented liquors in such circumstances. The only circumstances in which artificial cordials are admissible in such cases, are when the body labours under debility, or languor, constitutional or morbid, or where there is eminent danger from profuse hæmorrhage from a wound, in which case it is adviseable to administer freely pure spirits, or tincture of opium, in order to prevent the immediate extinction of life.*

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* Though it is this day (12th of April, 1822) forty years ago, the anxiety of Sir Charles Douglas in providing a sufficient number of these quills preparatory to the battle, is still fresh in the author's memory, and he distinctly recollects, that 60 of them were expended this morning at the gun to which he was attached.

After my return to England in the year 1783, I was enabled, from my own notes, and from information derived from the official records at the Navy Office, and at the Office of Sick and Wounded Seamen, to make out a statement of the whole loss of lives in the fleet in which I served as physician, from the beginning of 1780 till April 1783, a space of three years and three months.

It came out as follows:

Died of disease - - -	3200
Killed in battle - -	640
Died of wounds - - -	500
Total	4340

It is a very general and true remark, that in war more perish by disease than by the sword: in the present case the proportion is about three to one. We find the same remark made by ancient historians. Arrian, in his Narrative of the Expedition of Alexander the Great into India, makes the following remark: Ὁι δὲ ξυμπονȣ̃ντές τε ἔτι καὶ ξυγκινδυνεύοντες, αυτοί τε καὶ ἡ Μακεδονικὴ ϛρατιὰ, τοὺς μὲν εν ταῖς μάχαις ἀπολωλέκασιν, ὁι δὲ ἐκ τῶν τραυμάτων ἀπόμαχοι γενημένοι, ὁι πλέιȣς δὲ νόσῳ απολώλασιν. Arrian, Hist. Alexand. Expedit. l. v. c. 26.

Those who were lost at sea in ships of war in the hurricane of 1780, and in the great Atlantic storms in 1780 and 1782, in the former the Thunderer, and in the latter the Ville de Paris, Glorieux, and Hector, captured ships of the line, besides the Ramillies and Centaur, each of 74 guns, were lost, are not included in this statement. The number of men who perished at these disastrous periods amounted to more than 3000.

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* See this subject more fully treated, in a work entitled Elements of Medical Logic, Lond. 1821. Page 99, et seq.

It has appeared, from what is stated in the preceding article of this volume, how greatly the health of the navy has improved since the period which is the subject of this article. While I was a medical commissioner of the navy, I compared the numbers admitted into Haslar and Plymouth hospitals during the five years of war with France in the American contest, with the first five years of the late revolutionary war. I found, that in the former period the number exceeded that in the latter by 27,000, though a greater naval force was kept up, and a greater proportion of it on home service, than in the preceding war; and in 1811, a still more advanced period of the late war, I was informed by Dr. Baird, inspector of naval hospitals, that on comparing the five years then elapsed with the first five years of the war which began in 1793, he found that the amount of sickness and mortality of the latter was four times that of the former.

The assignable causes of these mighty improvements, which, while they are so highly conducive to the vital interests of the nation, may be considered as proud triumphs achieved in the cause of humanity, have been—

1st. The manning of the navy at the commencement of the late war with less impressing, and with circumstances less conducive to the engendering and diffusing of infection, than in former wars.

2ndly. The better observance of cleanliness, ventilation, dryness, and sobriety, in consequence of the general conviction of officers, of the necessity of these to the preservation of health; and that the due attention to them made an essential and indispensable part of their duty.

3dly. The general supply of lemon juice, so judiciously and liberally allowed to ships of war since the year 1796. By this the scurvy has been so entirely eradicated, or rather prevented, that there are now surgeons of the navy of long standing, who have never seen a case of it.

4thly. The regulations established by the Medical Board of the Navy, in the last years of the last century, already alluded to.

Lastly. The superior encouragement given to medical officers, which has had the effect of procuring a better educated class of men.

In order to render the advantage of the study of health in the present times, as compared with former ages, more palpable, I shall extract from history a few instances of those expeditions by sea, which have either been totally frustrated, or nearly so, by the neglect or ignorance of the means of preserving health.

The life at sea being more artificial than that at land, affords greater latitude both for good and bad management in the conduct of health. The losses and miscarriages of expeditions on this element, have by the records of history been both more numerous and more grievous than those by land. There is one disease, the scurvy, which has affected armies so rarely, and in so small a degree, that it may be reckoned peculiar to the sea service, of which it used to be the greatest scourge. Sir Richard Hawkins, an eminent commander and navigator, in the reign of Queen Elizabeth, mentions that in the course of twenty years, he had known of ten thousand men having perished by this disease; a prodigious number, when we reflect that the navy then was not more than a twentieth part of what it now is. The expedition to the West Indies and North America, in the year 1693, consisting of two ships of the line and six frigates, under Sir Francis Wheeler, miscarried in the attack on Martinique, by the force being weakened by sickness; and in his voyage home from America, the companies of his ships were so weakened by mortality and disease, that there were hardly hands enough to bring the ships into an English port. But perhaps, the most disastrous instance of the baneful effects of sickness in the public service, is in the expedition of Admiral Hosier, consisting of seven ships of the line, to the West Indies, to protect the trade in the year 1726. He buried his ships companies twice over, and in place of quelling and coercing the Spaniards, he was set at defiance and insulted by them, and died of a broken heart.* The expedition to the same quarter under Admiral Vernon, in 1740, was hardly less calamitous. The sufferings and dangers of Commodore Anson's crew, have been fully adverted to in the preceding Dissertation.

Since the middle of the last century, no expedition by sea can be said to have miscarried from the prevalence of disease alone: but in the course of the seven years war and the American war, six general engagements took place in the East Indies, every one of which were drawn battles. Is it not presumable that some of these might have proved victories, had it not been for the deficiency of hands in consequence of mortality and disease. The great difficulty, and even impossibility of replacing men on remote service, forms an additional motive for the study of health in distant and unhealthy climates. Lascars and Chinese were indeed, from necessity, employed in ships of war in the East Indies, to supply the great loss of seamen; but these feeble Asiaticks were found to be miserable substitutes for British seamen, whether for going aloft or at the guns. The late revolutionary war may be said to form a contrast with all preceding wars in point of health, and its unexampled glories are in no small degree imputable to this. And it is to be hoped that the methods of securing this invaluable blessing are now so rooted in the practical habits, experience, and convictions of naval officers of all descriptions; that, those scenes of misery and disaster which have been quoted from history, and which rend the heart in the narration, can never recur, should the nation ever again be involved in war; which in the common course of human affairs, can hardly be doubted.

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* See Charnock's Biographia Navalis.

[*To face page* 86.

TABLE I.

Shewing the Number of each Disease on board on the First of each Month, the Numbers sent to the Hospital, and who died, in the Course of the Month.

SHIPS' NAMES.	FEBRUARY, 1781.									MARCH.									APRIL.									MAY.									JUNE.								
	Fever.			Flux.			Scurvy.			Fever.			Flux.			Scurvy.			Fever.			Flux.			Scurvy.			Fever.			Flux.			Scurvy.			Fever.			Flux.			Scurvy.		
These marked , arrived with Lord Hood.	On board.	Sent to the Hospital.	Died.	On board.	Sent to the Hospital.	Died.	On board.	Sent to the Hospital.	Died.	On board.	Sent to the Hospital.	Died.	On board.	Sent to the Hospital.	Died.	On board.	Sent to the Hospital.	Died.	On board.	Sent to the Hospital.	Died.	On board.	Sent to the Hospital.	Died.	On board.	Sent to the Hospital.	Died.	On board.	Sent to the Hospital.	Died.	On board.	Sent to the Hospital.	Died.	On board.	Sent to the Hospital.	Died.	On board.	Sent to the Hospital.	Died.	On board.	Sent to the Hospital.	Died.	On board.	Sent to the Hospital.	Died.
dwich - -	8	0	0	4	0	0	2	0	0	8	3	1	4	0	0	2	2	0	6	0	2	9	1	1	2	4	0	2	2	1	10	5	0	5	18	0	2	0	0	3	0	0	10	0	1
rfleur - -	8	0	1	4	0	1	3	0	0	28	4	0	35	0	0	5	27	2	24	0	0	25	0	0	33	0	0	12	3	1	16	1	0	54	10	0	20	0	0	13	0	0	58	0	0
ibraltar - -	25	0	2	4	0	0	4	0	0	8	1	0	0	0	0	6	22	0	0	0	1	0	0	0	18	0	0	4	0	0	0	0	0	30	22	4	3	1	0	4	0	0	48	17	0
iumph - -	0	0	1	1	0	1	21	8	0	3	0	0	2	0	1	24	18	1	0	0	1	3	0	2	12	0	2	0	1	1	0	0	0	13	8	1	1	0	0	0	0	0	6	5	0
taur - -	2	0	0	2	0	0	20	0	8	7	0	0	4	0	0	50	0	8	2	0	0	3	1	0	55	1	1	0	0	0	2	0	2	15	4	0	4	0	0	9	0	1	15	0	0
rbay - -	6	0	0	11	0	0	1	0	0	7	0	0	8	0	0	8	0	0	6	0	0	8	0	0	23	27	2	6	0	0	13	7	0	44	31	0	16	0	0	6	0	0	9	0	1
narch - -	13	0	3	13	0	0	2	0	0	5	0	0	4	0	0	1	0	0	8	0	4	17	0	0	0	0	0	5	2	2	3	0	0	57	11	0	4	3	1	4	0	0	36	5	0
rible - -	2	0	0	10	0	0	1	0	0	2	0	0	9	0	2	3	0	0	0	0	0	10	0	0	4	3	1	0	0	1	10	4	0	5	20	0	3	1	0	12	0	0	20	1	0
ntagu - -	40	0	8	14	0	5	4	0	0	§	§	5	§	§	3	§		1	§	§	§	§	§	§	§	§	§	§	§	§	§	§	§	§	§	§	§	0	0	§	0	2	§	0	0
red - -	4	0	0	4	0	0	4	0	1	25	0	0	8	0	1	56	16	2	11	0	0	26	0	1	116	44	4	15	10	1	11	3	0	130	25	2	14	§	§	10	0	0	26	0	0
ssel - -	0	0	0	7	0	2	2	1	0	7	0	0	8	2	0	0	61	5	0	0	0	4	0	1	44	0	3	0	1	0	8	0	0	132	102	4	0	1	0	19	1	0	14	1	0
ide - -	1	0	1	9	0	0	1	0	0	1	0	0	1	0	0	15	0	0	1	0	0	3	0	0	8	16	0	0	0	1	1	0	0	40	35	0	4	2	0	5	0	0	26	5	0
vincible -	0	0	0	0	0	0	0	0	0	6	1	0	1	0	0	5	6	0	4	0	0	4	0	0	2	0	1	7	0	1	6	8	4	31	54	4	8	0	0	22	0	0	10	1	0
solution -	1	0	0	7	0	1	0	0	0	6	0	0	5	0	0	1	0	0	5	0	0	8	0	2	7	0	1	5	2	0	9	0	0	15	45	2	1	0	0	3	12	0	84	0	2
ewsbury -	8	0	0	0	1	1	6	7	0	5	0	1	6	0	0	0	0	0	4	3	0	0	0	0	4	6	0	3	1	0	5	2	0	22	6	2	3	§	§	4	§	§	20	§	§
x - - -	8	0	1	6	0	5	3	0	1	2	0	2	10	0	5	6	0	6	4	0	1	15	4	2	30	5	10	4	1	1	3	0	0	8	0	1	2	0	0	2	0	1	6	0	0
rincessa -	8	0	1	3	0	1	0	0	0	6	0	5	2	0	0	4	102	2	6	0	0	1	0	0	40	0	1	2	0	0	2	0	1	30	40	2	2	0	0	6	40	0	70	154	0
repid - -	18	1	1	10	4	0	1	0	0	10	0	0	9	0	0	0	0	0	9	§		13	§	§	1	§	§	§	§	§	§	§	§	§	§	§	§	§	§	§	§	§	§	§	§
elliqueux -	11	0	0	10	0	5	0	0	0	3	1	2	52	0	1	0	1	0	0	0	0	3	0	0	2	0	0	0	0	0	2	0	0	2	0	0	2	0	1	3	0	0	8	0	0
rince William	21	0	0	17	0	0	4	0	0	23	12	0	47	62	5	6	10	0	19	2	0	147	40	0	16	7	0	5	5	2	53	5	0	7	4	0	4	4	2	13	3	1	8	7	0
anther - -	2	0	0	4	0	0	0	0	0	5	0	0	8	0	0	4	0	0	2	0	0	4	3	0	9	1	0	3	2	0	8	4	0	1	0	0	3	0	0	8	1	0	1	1	0
iton - -	7	0	0	15	2	0	14	0	0	3	2	0	12	2	0	6	0	0	2	0	0	2	0	0	0	0	0	2	0	0	4	0	0	0	1	0	2	0	1	1	0	0	0	1	0
ena - -	0	0	0	0	0	0	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	3	0	1	2	0	0	5	0	0
clops - -	4	1	0	3	0	0	0	1	0	4	0	0	3	0	0	0	0	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	§	§	§	§	§	§	§	§	§
Total - -	197	2	19	158	7	21	93	19	10	174	24	16	238	67	18	202	265	27	115	5	9	317	49	9	428	115	26	76	30	12	166	39	7	641	436	22	101	12	6	149	57	5	480	198	4

N. B. Where the Spaces are marked thus §, no Return was made.

TABLE II.

ABSTRACT of the RETURNS for APRIL, 1782.

HIPS' NAMES.	FEVER.				FLUX.				SCURVY.				WOUNDS.			
	Sick on board on the 1st of the Month.	Put on the List during the Month.	Died.	Sent to the Hospital.	On board on the first.	Put on the List.	Died.	Sent to the Hospital.	On board on the first.	Put on the List.	Died.	Sent to the Hospital.	On board on the first.	Put on the List.	Died.	Sent to the Hospital.
*Formidable -	0	6	0	1	2	7	0	0	0	5	0	0	0	37	0	0
Barfleur - -	6	20	0	1	5	13	0	1	6	30	0	1	0	37	8	6
Prince George -	0	12	2	1	4	18	1	0	0	7	0	0	0	24	3	0
*Duke - -	57	78	2	32	0	3	0	0	0	1	0	0	0	60	2	0
*Namur -	5	14	0	2	11	9	0	3	8	5	0	2	0	25	0	0
Royal Oak -	1	4	0	0	11	23	0	3	1	1	0	1	0	54	5	15
Alfred - -	8	46	1	0	6	14	0	0	15	14	0	2	0	30	0	0
Montagu -	6	11	0	0	8	2	1	5	2	2	0	0	0	25	5	0
*Valiant - -	†	10	1	0	†	0	0	0	†	0	0	0	0	37	0	0
Monarch - -	5	21	1	0	3	10	0	1	0	1	0	1	0	33	2	1
*Warrior -	0	2	0	0	6	12	0	0	0	0	0	0	0	20	0	0
Centaur - -	12	20	0	1	10	15	0	1	5	15	0	0	0	14	0	0
*Magnificent -	0	21	0	0	0	8	0	0	7	16	0	0	0	20	0	0
Bedford - -	11	20	0	0	3	27	0	0	1	10	0	0	0	17	4	0
Ajax - -	0	0	0	0	0	0	0	0	0	0	0	0	0	30	1	5
Canada -	0	6	1	0	24	70	2	0	2	8	0	0	1	12	0	0
Resolution -	19	25	1	0	21	27	0	0	0	0	0	0	0	19	2	0
*Hercules -	2	38	0	4	5	18	0	0	0	12	0	2	0	18	0	0
Russel - -	3	3	0	0	5	4	0	0	0	1	0	0	4	29	3	1
*Fame - -	36	50	0	0	3	8	1	0	0	7	2	0	1	12	2	0
Torbay -	10	10	0	0	9	2	0	0	3	2	0	0	0	25	3	0
Princessa -	1	2	0	0	2	8	0	3	0	0	0	0	0	19	2	0
*Conqueror -	30	†	1	11	0	†	0	0	10	†	0	0	0	23	2	0
*Arrogant -	2	16	0	0	6	33	0	0	4	10	0	0	0	11	0	0
*Marlborough -	7	19	2	0	12	21	1	0	0	6	0	0	0	16	1	1
*Yarmouth -	0	3	0	0	4	3	0	0	3	3	0	0	0	33	2	0
Belliqueux -	43	118	0	0	6	4	0	2	0	3	0	0	0	10	0	0
Prince William	4	27	0	0	2	24	0	0	5	18	0	0	1	0	0	0
*Repulse -	20	40	0	0	2	2	0	0	3	2	0	0	0	9	1	0
St. Albans -	1	22	0	0	0	6	1	0	0	0	0	0	0	7	1	0
*Agamemnon	2	5	0	0	0	1	0	0	0	0	0	0	0	23	7	0
*Prothée -	6	13	1	0	5	49	0	0	0	0	0	0	0	24	2	0
America -	2	5	0	0	3	14	0	0	2	0	0	0	1	27	2	0
*Anson -	3	6	0	0	0	26	0	0	1	1	0	0	0	13	0	0
*Nonsuch -	6	11	1	0	0	4	0	0	18	25	0	6	0	2	0	0
Alcide - -	2	6	0	2	7	16	0	0	7	0	0	0	0	15	0	3
Ramillies -	†	26	1	4	†	6	0	0	†	3	0	3				
Nymph - -	2	7	0	0	8	9	0	0	0	0	0	0				
Flora - -	0	0	0	0	2	0	0	0	0	0	0	0				
Total - -	312	743	15	65	195	516	7	19	103	208	2	18	8	810	60	32

N. B. The Ships marked thus *, came from England in February and March, 1782.

All the Ships named in the Table were in the Engagements in April, except the Ramillies and the two Frigates.

In the Spaces marked thus †, no Return was made.

DISSERTATION III.

Containing Facts and Observations respecting INTERMITTENT FEVERS, *and the Exhalations which occasion them, collected chiefly on a Professional Mission to enquire and report on the Cause of the Sickness of the Army in Walcheren, in* 1809, *and to Northfleet, to report on the Expediency of establishing a Dock-Yard and Naval Arsenal at that place, in* 1810.

HAVING been sent by the Government of this country on a special mission to the Island of Walcheren, in the autumn of the year 1809, in order to ascertain the nature and causes of the great sickness and mortality, prevailing in the British army in Zealand, and to make a report of my enquiries; having been also sent by the Admiralty to Northfleet in the autumn of 1810, in order to investigate the nature and situation of that spot in point of health, with a view to decide, whether any objection in point of unhealthfulness would arise to the formation of a projected dock-yard, and other naval establishments at that place, some observations have occurred to me in executing these duties, which appeared to me sufficiently interesting to be laid before this Society,* and which I feel it my duty to record, as a warning to those who may hereafter plan military expeditions.

* The greater part of this article was first published in the Transactions of the Medico-Chirurgical Society, for 1812.

During my residence in Walcheren, I not only visited all the hospitals, but inspected, with the permission of the Commander in Chief, the whole returns of the army from the time of their disembarkation, in order to ascertain the progress and extent of the sickness and mortality. The result of these enquiries is what I now propose to communicate, and, in describing the nature, and detailing the ravages of the prevailing disorder, I shall borrow the greater part of what I have to say, from my official communications.

I arrived in the island on the 30th of September, and remained till the 13th of October following. During my stay I stated to the government, that I found so great a proportion of the sick to consist of those affected with the intermitting and remitting fevers, peculiar to marshy countries, that there could be no doubt that the sickness of the army was owing to that cause.

The fever commonly called typhus, with which armies in ordinary circumstances are chiefly affected, had been rare, and dysentery, which, in the history of former campaigns * in the Low Countries, proved the most severe scourge to our armies in the autumnal months, had been as yet but little felt. Both these diseases, however, had begun to shew themselves at Flushing, where the accommodations were, at best, far inferior to those at Middleburgh; but were then still more so, in consequence of most of the buildings having been injured by the shot and shells thrown into the town during the siege. In the large and elegant city of Middleburgh, the accomodations were excellent, as we had not only the advantage of the hospitals formerly belonging to the Dutch and French troops, but the spacious and airy warehouses of the Dutch East India Company, this having been formerly the great emporium of Indian Commerce. Here I found no typhus nor dysentery, but

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* See Sir J. Pringle's Work on the diseases of the army, in which there is a most accurate history of the diseases prevailing in the British armies in Zealand and other parts of the Low Countries.

the prevalence of these two diseases was very remarkable at Flushing, particularly in one regiment, of which all the medical officers were either absent or dead, and of which the sick originally affected with the endemic disease, were suffering also from typhus and dysentery, in consequence of the want of cleanliness, as well as of proper medicines, diet, and attendance. This fact affords a proof of the necessity of general hospitals on actual service, as well to prevent the generation and extension of infection, as to afford relief to the regimental establishments, when the sick and wounded accumulate beyond their means of accommodation. It is evident in the present instance, how necessary this is even in stationary service; but with regard to the ordinary service of a campaign, where armies are in motion, and where regimental surgeons and their assistants must be present with the regiments, general hospitals may be regarded as absolutely indispensable. No system, however, could be so bad as that of establishing general hospitals, to the exclusion of the regimental, which are indispensable in the movements of actual service, and have the advantage over the general hospitals, of being on a small scale, whereby they more easily escape the greatest of all evils attending hospitals, that of engendering infection by crowding.* There ought also to be a liberal establishment of medical officers attached to general hospitals, in case of emergencies of service, and to fill up such casual vacancies as may occur in regiments.

I found myself under the painful necessity, therefore, of stating, that the sickness on this island did not diminish. It appeared from the latest general weekly return, that there were two-thirds of the whole numeral strength of the army incapable of duty. The mortality during the last four weeks had been about 1000. All the battalions were affected nearly in an equal degree; and its does not appear, that their illness was connected with the nature of their duty, or that it was owing to privations or neglect of any kind; for those were equally sickly, who had enjoyed the utmost ease and comfort in cantonments, as those who had been engaged in the siege of Flushing.

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* See this ably discussed by Sir James M'Grigor, in an article in the Medico-Chir. Transactions, Vol. 6, p. 388.

Nor was this great sickness imputable to any thing unfavourable in the weather at this season, in comparison of former years. On the contrary, the native inhabitants affirmed, that they were then less sickly than usual at the same season of the year, and they accounted for this, from the uncommon quantity of rain that had fallen the last two months: for they consider it as fully established by observation, that the most sickly years are those, in which there had been great drought and heat in the latter end of summer and the early part of autumn; owing, no doubt, to the increased exhalation, and the more concentrated foulness of the stagnant water produced by these causes.

I found upon enquiry, that a like degree of sickness prevailed among the French troops who occupied Flushing during the last seven years; and that in former times, the Dutch troops, from the northern parts of the United Provinces, suffered equally. As the army had not suffered either from the scantiness and bad quality of provisions, nor from want of proper accommodation, nor from hardships and fatigue, it admits of no doubt, that the unfortunate state of the army here, was solely imputable to the contamination of the air from a soil the most productive of deleterious exhalations of any perhaps in Europe, producing an endemic fever which has at all times been particularly severe upon strangers in the autumnal months. I found also upon enquiry, that though this is by far the most sickly season, the residents of this and the neighbouring islands do not enjoy, at any season, the same degree of health as the inhabitants of the more salubrious parts of Europe.

From this statement, it will be clearly perceived, how much the causes of sickness were out of the reach of human controul. There were two facts, however, which afforded some encouragement for the employment of artificial means, in counteracting the overpowering influence of natural causes. One was, that those belonging to the upper orders of society in Walcheren were always less affected with its endemic fevers than the poorer inhabitants: the other, that the British officers suffered less in this campaign, than the private men, as will be seen by an abstract of the returns. As this latter must be owing to some circumstances of superior accommodation and diet, there was encouragement to attempt some improvement in these respects, though the situation of the common soldier was as comfortable as belongs to his condition. With this view I suggested the use of stoves in the barracks as well as the hospitals, in order to promote the dryness, warmth, and purity of the air. I also represented, that considerable benefit might arise from the men being supplied with a hot breakfast. It may likewise be remarked, that those who slept in the upper stories of houses, were less liable to the disease, and had it in a milder form, than those who slept on the ground floors. The testimony of the natives is in favour of this observation. We had a striking confirmation of it in the visit we paid to the party accommodated at Fort Rammekins. The same fact is well established in the West Indies. Dr. Ferguson, one of the principal medical officers of the army in St. Domingo in the late war, has remarked, that two-thirds more men were taken ill on the ground floors than on the upper stories. I have heard a similar observation made by Dr. Cullen, with regard to the sickness which prevailed at Porto Bello in the year 1740, where this eminent Professor in very early life was present. To the observation of General Monnet* (the French general who commanded during the siege) with respect to the good effect of a small quantity of ardent spirits in the morning, I may add a recommendation of mixing pepper freely with the broth and other articles of food.

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* General Monnet was an officer of good judgment and great experience. He commanded the French forces in Flushing during all the seven years in which it was in their possession. A memoir regarding the preservation of health was found among the papers he left behind him after the capture of the island, from which this remark is extracted.

There were, in the beginning of October, when I arrived, considerably more than one-half of the army sick, or convalescent in hospitals. This amount was not owing merely to the numbers accruing from those who were daily taken ill, but was swelled in consequence of the small number of discharges, and the numbers of convalescents waiting for a passage to England; for under the influence of endemial air, recoveries were slow and imperfect, and relapses very frequent, not only among the few who were discharged, but among the convalescents at the hospital, some of whom, when apparently in a fair way of doing well, would unaccountably drop down dead. This made me urge the conveyance of such subjects to England, with as little delay as possible. There were then 6000 subjects proper for being transported to England; and I recommended, in conjunctien with Dr. Macgrigor, the superintendant of the military hospitals, that line-of-battle ships, with their lower deck guns taken out, should be sent from England for this purpose, there being at Walcheren only the means of conveyance for 1000 men. This measure was rendered further necessary, by the rapid accumulation of sick in the hospitals, some of which were already over-crowded, and, if not relieved, must in themselves have proved a source of additional sickness and infection.

One of the most important circumstances in the operation of marsh miasma on the human body is the power of habit in mitigating its influence. The natives are not a robust people; they are of a very wan and sickly hue, with flaccid flesh, and have all suffered more or less from the bad air which they breathe. The children of both sexes are very subject to glandular and abdominal complaints; and the adults, particularly those of the lower orders, have all of them, some time or other in the course of their lives, laboured under the endemic intermittent. They are, however, infinitely less subject to intermittent fevers than strangers. It was curious to remark, in conversing with the natives, even persons of education, and medical practitioners, that they would not admit their country to be more unhealthy than any other; and when they were asked to account for the great sickness prevailing among our troops, they mentioned some trivial circumstance in diet and habits of life, but would allow nothing to be ascribed to the insalubrity of the air. However unfounded this prejudice may be, it is strongly expressive of the great difference in point of health between natives and strangers. These strangers are also variously affected according to the district from which they come. It was found, that of the British troops, the natives of mountainous countries, and dry soils, were more frequently affected than the natives of flat and moist districts. It is also well ascertained, that strangers, if they survive the first attacks, become thereafter much less liable to the endemic intermittents. This was well proved and illustrated in the *Mémoire* of General Monnet already quoted.

It was there recommended that troops should not be frequently changed; for when it was the custom to send battalions from Bergen op Zoom, every fourth-night, in succession, to work on the lines of Flushing, these men never failed, on their return, to be taken ill in great numbers. General Monnet therefore advised, however displeasing it might be to officers, that a stationary garrison should be retained in Walcheren, in order that it might be habituated to the air *(acclimaté,)* and he instanced a French regiment, which suffered in the second year of its being there only one-half the sickness and mortality which it suffered the first year, and hardly suffered at all the third. There were some other important remarks in this *Mémoire*, such as, that when it might be necessary to reinforce the garrison, this should be done early in winter, in order that the men might be habituated to the climate before the return of the sickly months, which he reckoned to be June, July, August, and September. He also recommended, that men who mount guard, or who are employed in any other duty exposing them to cold, damp, or fatigue, should have a double ration of spirits (genievre,) and that there should be an additional allowance of this, and also of vinegar during the sickly months. Another remark of this General was very consolatory to us at this time, namely, that the oldest inhabitant did not remember a year, in which this endemic had not disappeared before the end of October.

The expedition to Zealand sailed from the Downs on the 28th of July, and made good their landing on Walcheren, and North and South Beveland, on the 31st of July and the 1st of August. The only military operation of consequence was the siege of Flushing, which was invested on the 1st of August, and capitulated on the 15th of the same month. In the beginning of September, the islands of North and South Beveland were evacuated, and that part of the army which occupied them returned to England, about 18,000 being left to garrison Walcheren. More than one-half of these died, or were sent to England on account of sickness in the course of the three following months; and the island was finally evacuated on the 23rd of December of that year.

The following Tables exhibit a view of the course of the sickness and mortality. I was enabled to bring them down to the end of the campaign, the Commander in Chief having obligingly allowed me to extract from the returns deposited at the War Office, what was wanting in the notes which I had taken in Zealand.

I am also enabled to state, on the authority of Dr. Bancroft,* and Mr. Keate, the surgeon-general, that the whole number of sick sent to hospitals in Zealand, between the 21st of August and the 18th of November, 1809, amounted to 26,846, including relapses, and that the number of sick, including a small number of wounded conveyed from thence to England, between the 21st of August and the 16th of December, amounted to 12,863; and that many instances occurred in those who returned to England apparently in health, in whom the endemial disease of Zealand appeared after the slight fatigue of a march.

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* Essay on the Yellow Fever, page 303.

TABLE I.

Account of the Sickness and Mortality of the Army in the Islands of Zealand, abstracted from the Monthly Returns, 25th August, 1809, and the three subsequent Months.

Head Quarters, Fort Bathz, South Beveland.

Date of the Monthly Return.	Total.		Sick.			Died.	
	Rank and File and Non-Commissioned Officers.	Commissioned Officers.	In Quarters.	In Hospitals.	Total.	Rank and File and Non-Commissioned Officers.	Officers.
25 Aug. 1809	41642	1879	988	1713	2701	* 114	† 7

TABLE II.

Head Quarters, Middleburgh, in Walcheren.

Date of the Monthly Returns.	Total.		Sick.			Died.	
	Rank and File and Non-Commissioned Officers.	Commissioned Officers.	In Quarters.	In Hospitals.	Total.	Rank and File and Non-Commissioned Officers.	Officers.
25 Sep. 1809	16931	723	3829	5000	8829	883	29
25 Oct.	11921	611	2845	3027	5872	760	9
25 Nov.	6297	452	469	624	1093	196	3

* In this number 100 who were killed and died of wounds are included, so that only 14 died of disease.

† Of these one was killed as above, and 6 died of wounds, so that none died of disease.

TABLE III.

Account of the Sickness and Mortality in the Island of Walcheren, abstracted from the Weekly Returns, dated the 10th September and the eleven subsequent Weeks.

Date of the Weekly Return.	Rank and File and Non-Commissioned Officers.			Officers.		
	Total.	Sick.	Died.	Total.	Sick.	Died.
10 September	17870	6931	221	770	No ret.	4
17	17410	8141	277	765	235	7
24	16409	8754	287	782	191	3
1 October ..	16156	9127	254	748	172	2
8	15276	8969	217	719	168	3
16	....	....	Return	mislaid	..	
23	13017	7145	128	655	113	
31	11747	6228	121	292	80	1
7 November	....	....	Return	mislaid	..	
14	8868	3799	40	559	45	
21	7926	1226	36	543	47	
29	6261	1158	30	383	30	

The first circumstance which strikes the eye on inspecting these Tables, is the smallness of the mortality in the first month of service. This not only proves, that several weeks are necessary for these deleterious exhalations to act upon the system, so as to produce disease, but that the rate of this mortality is so much less than in ordinary circumstances, as to stagger one's belief. According to the statement here exhibited, only 14 died of disease in 41462 in a calendar month, and not one officer. I at first distrusted my own accuracy in making the abstract; but repeated examination convinced me that I was correct. I next distrusted the accuracy of the returns, but the adjutant-general assured me that there was not the smallest reason to suspect an error. According to the population returns of 1801, the smallest degree of mortality in any of the counties of

England and Wales, was in Pembrokeshire; and was 1 in 76. The greatest mortality was in London; and was 1 in 31. But it is not fair to compare the mortality of an army, with that of the general population; for the latter includes all ages, sexes, and constitutions, whereas the former consists of the robust part of the male sex, in the prime of life. The computation being made on the like class, it would appear, that there is a much smaller rate of mortality than in people of the same age in England; for, as has been remarked at page 22, the mortality in civil life at this age in England is 1 in 98, and in select cases 1 in 130; but the annual rate of it in this army, if computed by the month ending the 26th of August, would be only 1 in 248.

This low rate of mortality will appear in a still more striking point of view, when compared with that of fleets and armies elsewhere: for at Coxheath, in the year 1779,* the annual mortality was at the rate of 1 in 109; and during the time in which I kept records of the fleet in the West Indies, the lowest in any month, April 1782, was equal to an annual mortality of 1 in 72; and the actual annual mortality about that time in the army on that station was 1 in 4, and in some particular spots more than one half.

The smallness of this rate of mortality in Zealand at this period, could not therefore be owing to the superior health and strength of those men who compose an army, above the persons of the same age, on whom the calculation is made in civil life. Was it not owing to this, that in the beginning of an expedition, men's minds are in that elated state, from the sanguine hopes of victory and success, which is favourable to health? I have remarked in the preceding Dissertation, page 79, as well as elsewhere,† that in fleets, impressions of this kind have a striking effect on the health of men. An excited tone of mind, therefore, as well as youth and robust health, had a share in keeping down the mortality at this period. This however was of short duration : for it will be seen by the Table, that the sick had begun to increase rapidly at this time; and that before the 10th of September, the mortality had become very great. As there is no account in these Tables, of the numbers taken ill in the intermediate times, nor of those discharged cured; nor any accurate statement of the number sent to England from time to time, we have no scale of the decreasing sickness, as the season changed; except the weekly diminution of the number of effective men. Thus it will appear by subtracting the sick from the total, as stated in Table 3rd, that in the week between the 17th and 24th of September, the effective force was reduced from 9269, to 7655, so that 1 in 5.7, that is, about 2 in 11, had in that time become unfit for duty. It will appear by a like calculation, that on the 23d of October, the effective force was reduced to 5872; and that in the course of the succeeding week, it was reduced to 5519; so that 353 had in that time become unfit for duty, that is, 1 in 16.6, a proportion less than that in the preceding weeks; the most susceptible being first taken ill: but the total seizures in five weeks was such as to reduce the effective force to less than one-third. No fair judgment can be formed from the returns of November, for reinforcements, of the amount of which I am uninformed, arrived from England in the course of that month, to assist in the evacuation of the island. From all the evidence however, I could procure, the number of seizures continued to diminish as the winter approached and advanced, conformably to what we had been told by the natives.

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* See Blane's Observations on the Diseases of Seamen, page 170. Third Edition.

† Ibid. page 77.

The island of Walcheren is 13 miles long from east to west, and 9 miles from north to south. The capital of this island and of all Zealand, is Middleburgh, an open town in the centre of the island, but communicating with the sea by a broad and deep canal, continued from a natural navigable inlet, leading to Rammekens, on the south-east quarter of the island. Flushing, on the south side of the island, is the principal sea-port and arsenal, and the only place of strength. The whole island, with the exception of some hills, or rather mounds of sand on the western shore, is a dead flat, below the level of the sea at high water, and preserved from inundation by dykes. The soil consists of a fine white sand, known in the eastern counties of England, by the name of silt, and about a third part of clay. It is divided into small square inclosures, by ditches, which serve as drains; and these were about two-thirds full of turbid water, when I was there. They emit no smell, that I could perceive; but I was sensible of a bad smell proceeding from some ponds of stagnating water. The soil seems to be a mass of alluvial matter like the deltas of great rivers; and the whole islands of Zealand seem to have been formed by the *detritus* carried down by the Rhine and Scheldt, and forming accumulations for a long series of ages. There is a poison in the exhalations from such soils, the nature of which is entirely unknown. It is not animal putrefaction; for it is perfectly well ascertained, that those who are exposed to putrid vapors, such as anatomists and tanners, are not affected by complaints of this kind; nor indeed by any complaint, unless these vapors are very concentrated; and the disease in that case is not an intermittent fever. Water in a state of stagnation, without any ascertainable principle of contamination, seems to generate these miasmata, particularly after it has undergone exhalation, so as to be brought to the consistence of mud. It is only from the absence of stagnation, that we can account for the Delta of the Nile, not producing the same disease as Zealand. This is so far from being the case, that Lower Egypt is one of the most healthful countries in the world, and is not infested with endemic intermittents. This remark did not escape the geographer* Strabo; and he assigns as the cause that the stagnation of the water was prevented by the annual inundation of the Nile. It appears also, from a work of Sir James Macgrigor, that intermittent fevers, though not unknown, are not endemic in Egypt.* On the other hand, we know from the medical history of Minorca,† that, though this island consists of a rocky bottom, and very thin soil, yet in consequence of some stagnant water in channels and pools, severe intermittents are very common. I need hardly mention, that the plague is no exception, this being a disease depending on *human* effluvia, and entirely unconnected with the nature of the soil.

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* Vid. Strabon. Geograph. lib. 17, page 1143, Amstelodam, 1707.

An intelligent general officer, Sir John Moore, who was employed on the expedition to Egypt in the year 1800, and who had served in all climates, assured me, that he had no where seen so little sickness and mortality from disease; for sickness, even including the plague, was less destructive than in any other country in which he had served; insomuch, that there was here an exception to a rule, which holds everywhere else, that disease is more fatal than the sword; for more were killed, or died by wounds, than by sickness, including even those who died of the plague. Nor can it be alleged, that humidity alone may have the effect of producing intermittent fevers; for the vapour of pure fresh water, when not in a state of long stagnation, is found to be free from any bad effects upon the greater number of constitutions. It is remarkable, that though much greater quantities of rain fall in the western parts of England than the eastern, the average in some counties of the former being nearly double of what it is in those of the latter, yet it does not appear that health is in the least affected by this circumstance; and seamen, even in the thickest fogs on the banks of Newfoundland, for many days together, preserve their health perfectly. This poison, therefore, is some principle, with the nature of which we are still unacquainted. There are also certain species of decayed organic matter, the exhalations from which are not at all productive of agues nor any other disorder. I allude to bogs or peat-mosses. This is fully proved in Scotland, but still more in Ireland, where there are immense tracts of this soil, without any hurtful influence upon health. It might naturally be expected also, that the swamps round Venice would be productive of endemic fevers. This is not the case; and it is probably owing to the water which forms them being sea-water.

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* Vid. Medical Sketches of the Expedition to Egypt from India, by James Macgrigor, M. D. page 99 and 163. London, 1804.

† Vid. Cleghorn on the Diseases of Minorca.

The *miasmata* in Zealand, are more noxious than the like exhalations in England; the intermittents in the former, being more violent, untractable, and fatal, than those which occur in the fenny counties, in the eastern parts of our own country. I estimate this violence, by the high degree of febrile heat and delirium, by the excessive secretion of bile, the want of distinct intermissions, and the more frequent swellings of the liver and spleen, these taking place in the course of a very few weeks, which in England seldom occur but under a long continuance, or from frequent relapses of the disease.

The exhalations of the soil in tropical climates extend farther, and are still more malignant than those of Zealand. Ships at the distance of 3000 feet from swampy shores, (a distance to which it did not extend in Zealand,) and even farther, were affected by the noxious exhalations, according to my own observations and those of others in the West-Indies; and I have been credibly informed of the like fact, with regard to the India ships in the channel which leads to Calcutta. This greater density and malignity of the exhalations might naturally be expected from the greater intensity of atmospheric heat.

A medical gentleman belonging to the army in St. Lucia, one of the Caribbee islands, in the year 1781, at which time I was physician to the fleet on that station, favoured me with the following statement, and accompanying Table, which throw considerable light on the subject here treated of.

" The fevers in general are of the low kind, terminating " in intermittents.

" Unhealthy situations are the causes of many diseases " here, particularly the worst sort of fever and inter- " mittents.

" One regiment, viz. the 90th, on the Morne Fortunée, " lost 271 men; the 91st on the side of the hill 318; the " 89th in *Grand Cul de Sac* at the bottom 486.

" The hill, or morne, is above the level of the sea 872 " feet."

It is evident, that the severity of the symptoms, in the Zealand fever, added greatly to the difficulty of the cure; and there could be no opportunity of employing Peruvian bark or other specific remedies, till its violence had abated, and the redundant bile had been carried off. The treatment of this acute state, consisted chiefly in giving such remedies as purged freely; and in selecting them, the preference was due to those which acted most readily on the liver and the bile, such as calomel; those which were least heating, as the neutral salts; and such as were best borne by the stomach, which, in a great many cases, was extremely irritable. In the course of the general inspection, in which my duty consisted at this time, I had not myself an opportunity of directing and watching the practical details of individual cases; but I had considerable experience in this way, in my attendance on officers in England, who either brought the complaint with them, or were seized on the passage, or after their return to this country. I found that carbonate of magnesia, given as a purgative, in effervescence with lemon juice, remained on the stomach, when other remedies of this class were rejected by vomiting.

One of the medical controversies respecting the cause of intermittents, is founded on the difference of opinion on the question, how far the excess of bile may be considered as

STATE OF SICKNESS AND MORTALITY IN THE ARMY AT ST. LUCIA.

Strength of the Garrison.	The different Months.	Men in Garrison for Duty.	In Gen^{l}. Hospitals.				Prevailing Diseases.	Number of Sick.	Monthly Deaths.	In Regt^{l}. Hospitals.				Prevailing Diseases.	Number of Sick.	Monthly Deaths.	Total Sick.	Total Deaths.
			Fevers.	Agues.	Fluxes.	Dropsy.				Fevers.	Agues.	Fluxes.	Dropsy.					
2325	May........	1784	50	14	36	5	Fever.	105	43	61	56	313	6	Flux.	436	16	541	59
1737	June........	1093	57	9	43	4	Do.	113	68	65	56	413	0	Do.	534	68	644	130
*1912	July........	1012	42	8	51	1	Flux.	102	68	105	94	589	10	Do.	798	125	900	193
1989	August......	1084	34	19	83	8	Do.	144	110	127	202	427	5	Do.	761	142	905	252
1582	September...	899	33	29	86	10	Do.	158	101	100	161	261	3	Do.	525	152	683	253
1533	October.....	837	27	29	77	5	Do.	138	56	179	183	196	0	Do.	558	156	696	212
1401	November...	801	25	38	64	4	Do.	131	74	87	166	214	2	Do.	469	65	600	139
1286	December...	883	21	28	49	2	Do.	100	54	60	77	164	2	Do.	363	51	403	105
1268	January.....	942	11	38	60	1	Do.	110	69	51	70	104	1	Do.	230	32	325	101
†1540	February....	1230	14	20	67	3	Do	104	41	47	69	104	0	Do.	220	40	310	81
1554	March......	1233	4	12	49	3	Do.	68	32	77	80	93	3	Do.	253	32	321	64
1442	April.......	1172	12	21	33	0	Do.	66	15	72	68	71	1	Fever.	212	29	278	44
			Died in the Gen^{l}. Hospital........						731	Died in Regt^{l}. Hospital........						908	Total	1639

* 46th and 5th Regiments joined.

† 37th Regiment joined.

the cause of them. It certainly cannot, in correct language, be called the cause; otherwise every case of redundant bile, such as the *cholera morbus*, would be attended or followed by an ague. Certain it is, however, that epidemic intermittents not only occur exclusively in those seasons in which an excessive secretion of bile is most apt to arise, but every attack, whether original or relapsed, which I have seen, bore evident marks of an excessive flow of this humour. They seem, therefore, to stand to each other in the relation of concomitant effects of the same cause, and not in that of cause and effect, so that the true statement of the fact perhaps is, that that state of the body, in which there is the strongest tendency to a copious secretion of bile, either from the natural constitution, or the season of the year, constitutes a predisposition favourable to the action of the poisonous exhalations. There seems in this something analogous to other facts which I have elsewhere noticed, respecting the plague and the yellow fever, namely, that the human body is not liable to be affected by them, unless when predisposed by a certain temperature of the atmosphere. If the attack of this disease depended merely on the quantity of the exhalations, they would be most frequent in June and July, when the heat of the atmosphere is highest. But there is a still more decisive proof of its depending on that season, in which the secretion of bile is most copious, from this fact, that when those who have imbibed the poison, are transported into countries where the air is in a state of greatest purity, it is in the autumnal months that they are most commonly attacked. There was a very striking proof of this after the campaign of North Holland in 1799. In the following year some of the officers and men who had escaped the disease, were taken ill in the autumnal months; and none, that I heard of, at any other season of the year.

The greatest difficulties which occurred in the cure of those severe intermittents in their early stages, proceeded from great irritability of the stomach, which rendered it very difficult to exhibit either purgatives with a view to procure intermissions, or bark in sufficient quantity after intermissions had been procured. The best means, I found, of obviating the first difficulty, was to purge with calomel, which, besides the advantage already mentioned, is, on account of its small bulk, swallowed without repugnance, and, by its weight, is not easily rejected after being swallowed. Its operation should be assisted by neutral salts, and if these should be rejected, by considerable quantities of carbonated magnesia given in effervescence with lemon juice. It is sometimes, though very rarely, advisable to give mercury as an alterative. Ramazini* relates, that a person affected with an obstinate ague was cured by mercurial friction administered for the lues venerea.—The second difficulty is one of considerable magnitude; for it is of the utmost practical importance to prevent the recurrence of paroxysms at as early a stage of the disease as possible; but the intensity of the fever, the imperfect intermissions, the obstructed viscera, and the inordinate secretion of bile in the Zealand intermittents, form serious obstacles to the early administration of specifics, particularly the bark. The rejection of this by the stomach was obviated by substituting opium and arsenic with great caution and discretion. The stomachs of some patients were reconciled to the bark, by administering it with opium or magnesia in effervescence, or both: to others it was so insuperably offensive, that it could not be borne in any form, quantity, or combination. In these cases, the cure was effected by opium and arsenic, along with such bitters and aromatics, as the stomach would bear. Where the periodical paroxysms had not ceased, the tincture of opium was given from 30 to 50 minims, in the intermission, a few hours before the expected hour of seizure, accompanied with as much rhubarb as would counteract its restringent effects, keeping the patient warm in bed, and supplying him with hot drink. Sometimes the first administration of this stopped the paroxysm; but more commonly only alleviated it, and did not stop it till the second or third time. After the paroxysms were stopped, it was continued in smaller doses at the former periods; and either bark, or, if the stomach would not bear it, arsenic * was given in the intervals, till it might reasonably be supposed that the tendency to relapse had ceased. At this period, carbonate of iron was also given with safety and advantage, and with still more benefit at a more advanced period, in order to obviate debility and emaciation, and to afford a still greater security against relapse, when there were no remains of fever, nor suspicion of local affection. I have cured intermittent fevers in which bark had failed, both in the West Indies† and in St. Thomas's hospital, with the oxyde of zinc; but I have made little use of this remedy since I became acquainted with the superior powers of opium and arsenic.

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* De morbis artificum.

The duration of this tendency to relapse was very indefinite. There is a subtle, incomprehensible impression made on the living human body by marshy exhalations, which, though attended with no immediate visible effect, so modify the constitution, that many months, and even years afterwards, though the person has been living all the while in a pure air, an intermittent fever arises sometimes, without any visible exciting cause; but most frequently in consequence of cold, fatigue, watching, privation of some kind, or, as has been before mentioned, on the return of the autumn. This, as has been already remarked, was strikingly exemplified in the troops who had served in the campaign in North Holland in September and October, 1799. Among these, was an officer who came to town to put himself under my care, in the month of August in the following year. He

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* The dose was from six to twelve drops of the liquor arsenicalis of the London Pharmacopœia, three times a day.

† See Observations on the Diseases of Seamen, page 442. Third Edition.

belonged to an encampment at Swinley near Windsor, a district not liable to such complaints; and he informed me, that not only himself, but others who had not been affected in Holland, had been seized with intermittents, and that this disorder was confined to those who had been in the above-mentioned campaign. I was informed in February, 1811, by a field officer, who came home from Portugal on account of bad health, that those men of his own regiment, as well as of others, who had served before in Walcheren, were, upon the first exposure and fatigue, rendered unfit for duty, chiefly by remittent fevers, so as to leave not more than a third part of them fit for service, a proportion of sick, far above that of the army in general. This tendency is still stronger, if the person had actually suffered from immediate exposure to these exhalations; a consideration which obviously suggests the necessity of continuing the remedies for a considerable time after all the symptoms of the complaint have subsided, and also of avoiding the exciting causes above enumerated.

I had, in the course of this service, an opportunity of observing the extent to which the noxious exhalations extended, which was found to be less than is, I believe, generally known. Not only the crews of the ships in the road of Flushing were entirely free from this endemic, but also the guardships, which were stationed in the narrow channel between this island and Beveland. The width of this channel is about 6000 feet: yet, though some of the ships lay much nearer to one shore, than to the other, there was no instance of any of the men or officers being taken ill with the same disorder, as that with which the troops on shore were affected.

It may not be improper here to glance at some of the principal disasters and miscarriages recorded in history, which have befallen armies, as has been already stated with regard to fleets. In this enumeration, perhaps, the crusades should stand foremost. But as the human mind in those ages, laboured under a species of epidemic insanity, a narrative of this unexampled waste of human life from disease and privations, imputable to improvidence and neglect, can carry but little instruction in the ordinary conduct of human affairs. Let us rather quote what history records of the invasion of England by William the Conqueror, whose army was rendered nearly inefficient by the dysentery, and whose success was owing to the divisions and imbecility of his enemies: or let us turn our eyes to what is related of the army of Henry V. which was reduced by the same malady from 59,000. to 10,000. men, previous to the battle of Agincourt, which, making every allowance for the difference of national prowess, was lost by the French from the misconduct of their princes, who commanded an army more vigorous and better appointed, and which out numbered the English in the proportion of four to one. The calamitous state of the army brought to England by Henry VII. previous to the battle of Bosworth, seems to have exceeded the miseries of either of these, for having been long detained in France and at sea from political causes, under singular circumstances of filth, scanty and bad provisions, and deficient clothing, they suffered, not merely from the ordinary sickness and mortality incident to such a situation, but they actually engendered a new pestilential disease, the sweating sickness; which afflicted England for near seventy years afterwards. To these may be added the expedition to Cadiz under the Duke of Buckingham, in 1625, which was frustrated by sickness and want of discipline. The only memorable disasters imputable to sickness which occurred in the late war, were those which occurred in the expeditions to St. Domingo and Walcheren. And though these were chiefly imputable to soil and climate, circumstances beyond human control, it is to be hoped that they will serve in all time to come, to enforce the necessity of statesmen rendering themselves acquainted with them, in calculating the risks of war. With regard to the service in the peninsula, which forms the great feature of the late war, there was perhaps no point in which the military skill of the renowned leader shone with more lustre, than in the arrangements and foresight, by which he preserved the troops in a state of efficient health. If there was any exception to this, it was in the state of the army after the retreat from Burgos, in the year 1813. In consequence of heavy rains, inclement weather, and other adverse circumstances, sickness made an alarming progress, and had it not been for the energetic measures, preventive, curative, and restorative, which neither by sea nor land have been understood, or practised till our times, adopted under the direction of Sir James M'Grigor, the Director-General of Hospitals, seconded by the illustrious commander the Duke of Wellington, the army would have been in no condition to meet the enemy in a few months afterward in the fields of Vittoria.

What the author means to evince by these remarks is, that though history informs us of the success of armies under circumstances of the greatest neglect of health; this must be imputed, in most cases, to the like neglect of the enemy; and it is clear, that by those practicable precautions, by which the health and lives of men may be preserved, a decided advantage in the saving of blood, treasure, and ultimate success, must arise to that party which employs them, over that which neglects them. The King of Prussia has remarked, in the History of his Own Wars, that fever * cost him as many men as seven battles.

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* This statement of His Prussian Majesty may perhaps be understood as a rough computation of the whole loss from sickness in his armies in the course of the seven years war, and is probably much short of the real loss from this cause. There were indeed circumstances favourable to health in these campaigns, such as the seat of war not being in countries subject to endemic disorders, the armies never being so long encamped on one spot, as to engender much con-

He won many battles, but he also lost several, and would probably have lost fewer, had the means of maintaining health been better understood. There is a fine trait recorded by Plutarch, in his Life of Alexander the Great, from which it appears that some knowledge of medicine made part of his education, and that this mighty conqueror did not disdain to tend his friends in their illness, to compound and administer their medicines, and even their diet, being not merely a speculative *amateur*, but an actual practitioner of physic;* and affords no bad reproof to that

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tagion, and the most exemplary discipline. Nevertheless, as the King at the conclusion of his history, states that he had fought sixteen pitched battles, and computes his total loss in the war at 180,000 men, the number of deaths merely from the casualties of war will not account for so great a loss; and if a more rigid calculation were to be made, it would probably be found nearer the truth to say, (with all that diffidence and deference so highly due to His Majesty,) that the loss by sickness, instead of being equal to that of seven battles, was more than equal to all those who fell in the battles, skirmishes, and sieges. In the most favourable circumstances, the mortality from the fatigues, exposure, and privations inseparable from war, will ever greatly exceed that of the same class of men in civil life. In proof of the great advantage of keeping armies in motion, I may quote what I learned from General Pichegru, whom I attended in an illness after his escape from Cayenne. Though he kept the field for two successive winters, which I believe is unexampled in the history of the wars in that quarter of Europe, yet no sickness arose in the armies which he led, except in a detachment which he sent to take possession of Sluys, in Dutch Flanders, which suffered from endemic fever. His army was not provided with tents; their only shelter in the field was huts. This high degree of health seems chiefly ascribable to the frequent movement of their position, the ample supplies derived from unsparing requisitions, and something may, no doubt, be attributed to the moral effect of political and military enthusiasm.

* Δοκεῖ δὲ μοι καὶ τὸ φιλιατρεῖν Ἀλεξάνδρῳ προτρέψασθαι μᾶλλον ἑτέρων Ἀριϛοτέλης. οὐ γὰρ μόνον τὴν θεωρίαν ἠγάπησεν, ἀλλὰ καὶ νοσοῦσιν ἐβοήθει τοῖς φίλοις, καὶ συνέταττε θεραπείας τινὰς καὶ διαίτας, ὡς ἐκ τῶν ἐπιϛολῶν λαβεῖν ἐϛιν.

barbarous pride of birth and rank, the rust of feudal ages, now disappearing, which treated all the useful and liberal arts with contempt.

It appears upon the whole, that the disorders, the prevention of which are chiefly under the control of commanders, are dysentery and typhus fever. Those depending on soil and climate are much less so; but sufficient examples have been adduced to convince statesmen, and leaders of armies, that they would do well to make this one of the main elements of their deliberation in the planning of military expeditions.

Report of Mission to Northfleet.

I had an opportunity of farther proving and illustrating the observations regarding the miasmata of soils, in the service I was sent upon to Northfleet in the autumn of the year 1810. The spot upon which it was intended to erect the proposed dock-yard and arsenal, is a marsh of about 700 acres. On the banks of the river, both above and below it, there is soil of a similar description, but not immediately adjoining to it on either side; for above is the village of Green Hithe, which stands on a chalky bottom, rising to a few inches below the surface, and is a projecting point of the general chalky hills which compose the adjacent country. Below it, on the bank of the river, there is a similar intervention of the chalk, where the village of Northfleet stands. Both these are nearly on a level with the marsh; yet the intermittent fevers are almost unknown at either of them, whereas they are extremely prevalent on the adjacent hills. I found this fact analogous to some others to which my enquiries at this time led me. Dr. Maton informed me, that, in the neighbourhood of Weymouth, though there is stagnating water near the sea, producing intermittents, these disorders are not known in the dry districts on each side, on a level with the water, but prevail on the adjacent hills. A Cornish gentleman stated to me, that at St. Blazey, between St. Austle and Lestwithiel, agues prevail much on a hill adjoining to a marsh contiguous to the sea beach. And Major Rennell, the celebrated geographer, says, that in a district which he surveyed on the river Burrampooter, the waters of which overflow, and, upon retiring, leave an oozy flat, the agues prevail to the very summit of the adjoining hills. Lancisi* mentions a hill, on which the same sickness prevails, as in the marshy lands at the foot of it. An instance of the same fact in St. Lucia, has been already mentioned.

It is known to every one, ever so little acquainted with the operations of nature, and indeed the common phenomena of clouds and rain render it obvious to the most ordinary observer, that water recently exhaled from the surface of the earth, has a tendency to ascend, and being lifted over parts on the same level, impinges on the neighbouring heights. There is reason to believe, that impure and unwholesome particles in general are attracted by watery vapors, for it is remarkable, that, in case of fogs, offensive smells are perceived, which in a dry state of the air, were fixed and quiescent. Though pure humidity, therefore, is innocuous, it may prove pernicious as a vehicle of unwholesome volatile matter. In like manner, the poisonous principle of marshes, whatever it is, being engendered by moist soils, will naturally adhere to the watery vapors, and ascend with them.

There are facts to prove, that certain artificial changes, tend greatly to improve the air of particular spots. It is well ascertained, by the records of physic, by the bills of mortality, and by civil† history, that intermittent fevers were very prevalent in London, before the formation of common sewers, and the adoption of other means, such as paving, conducive to cleanliness and dryness, to which more perhaps than to the improved habits of life, in point of diet, may be ascribed the unexampled state of health in this great metropolis. There is a still stronger proof and illustration of this in Portsmouth, which is built upon a flat, composing part of the marshy island of Portsea. I am assured by a medical gentleman who practised there, but is now retired from practice, that when he first knew that place, intermittent fevers were very prevalent; but the town having been drained and paved in the year 1769, tha disorder had since been unknown there.* Hilsea and other parts of the Island of Portsea have retained the same aguish character; but this disease has greatly decreased there also, since a drainage which was made in the year 1793. Numberless other examples might be adduced in proof of this, derived from the general improved state of health in various parts of the kingdom, in consequence of the inclosure of commons for the purpose of agricultural improvements, of which draining is one of the principal. This has been felt on the spot now in question, for I am assured by the Rev. Mr. Crackhilt, who has resided in the parish of Northfleet, for 42 years, that there has been in that time a progressive amelioration in point of health. It may indeed be affirmed as a general truth, that, all over the world, the great difference of one country from another, in point of salubrity, consists in the greater or less proportion of that soil, which exhales those noxious effluvia, which produce intermittent and remittent fevers.

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* Vid. Lancisi de Noxiis Paludum Effluviis, page 120. Rom. 1717.

† King James the First, and Oliver Cromwell, both died of agues contracted in London.

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* It appears from the late Parliamentary Report, that Portsmouth has had an accession to its population, during the preceding ten years, of 8401 inhabitants; that the healthfulness of it has encreased, the proportion of deaths in 1800 having been one in 28; in 1810, one in 35; both computations being taken on an average of three years. Plymouth in the same time has acquired an additional population of 12,866, and the mortality has varied but little, having been one in 27, in 1800, and not quite one in 28, in 1810. The population of Portsmouth, by the last Report, was 40,567; that of Plymouth, 56,060.

One of the objects prescribed to me on my visit to Northfleet, was to ascertain how far the health of that spot might be affected by the exhalations from the Essex side of the river. What has already been said on this subject relating to Zealand, affords an answer to this question; the width of the channel between Walcheren and Beveland being about six thousand feet, and the breadth of the river at Northfleet, according to a plan in the possession of Mr. Rennie, the engineer, being three thousand feet. The distance of Essex from the banks of the river at Northfleet, is therefore about the same as between the ships riding in the middle of the channel, between the shores of Walcheren and Beveland. I found however, from the most accurate enquiry, that the endemic fever had not spread to the ships of war stationed between the Islands, though some of them were nearer the shore than the middle of the channel. Neither were the seamen of the ships in the roads of Flushing affected with this fever.

I was farther informed by Mr. Rennie, that in boring the ground at Northfleet, he found that there were beds of chalk and gravel underneath the clay; so that these materials, when they shall be thrown up in making the future excavations, would render the surface dry and wholesome, and that he had calculated that their quantity would be such, as to raise the artificial surface eighteen feet higher than the present natural surface.

Taking into consideration, therefore, the great changes which would take place in the marshy spot, on which it was proposed to erect the docks and arsenals; in consequence of the excavations, the drainings, the pavings, buildings, and various other operations for forges and other machinery, I gave it as my opinion, that no solid objection would arise to the plan proposed.

DISSERTATION IV.*

On the COMPARATIVE PREVALENCE *and* MORTALITY *of different* DISEASES *in* LONDON; *illustrated by Abstracts of Cases which occurred to the Author at St. Thomas's Hospital, and in his private Practice, embracing a period of Twenty Years; with an Appendix, containing some Remarks on the Comparative Health and Population of England and Wales.*

THE history of diseases in different ages, as a branch of general knowledge deeply interesting to the human race, would be sufficiently important to command the attention of the intelligent part of mankind, independently of its application to professional purposes. A little reflection, however, will shew that such knowledge is highly conducive, and even indispensable to the cultivation of practical medicine, and the regulation of medical police.

It was a remark which I heard made, and illustrated with his characteristic profoundness and precision, by Professor Adam Ferguson, in his Lectures on Moral Philosophy in the University of Edinburgh, that all observation is suggested by comparison. He might have added, that all practical deductions, whether in common life or in physical science, are grounded upon it, corrected and extended by it. As all practical researches ought to be built on an induction of facts, single objects or events are of little value except in so far as they stand related to others: and when numerous objects and events present themselves in uniform combination, it is only by varying them and comparing them with others that useful inferences can be drawn from them, and that the relation of cause and effect can be distinguished from casual coincidence or simple succession. Those physical agencies, on the discovery of which all practical knowledge is built, and those analogies in which all suggestions and rational conjectures originate, can only be ascertained by an enlarged view of nature, which, by enabling us both to elicit new truths and to adapt means to ends, may be considered as at once the instrument and the light by which we work, whether in art or science.

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* This Dissertation is taken from the fourth volume of the Medico-Chirurgical Transactions, published in 1813; but many new facts and illustrations are added in this republication.

It could easily be shewn how much more applicable these remarks are to medicine than to any other art or science, from the peculiar intricacy and complexity of the objects about which it is conversant, and the more numerous *sources of fallacy and error incident to it, no less from the superstition and credulity of rude ages, and of the ignorant and vulgar in all ages, than from those hypothetical and spurious reasonings engendered by false physiology and pathology, and by the perverted application of general science, in the learned ages.

But as abstract disquisition does not belong to this place, and as I have elsewhere † attempted an outline of this

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* The like sentiment is happily expressed by Bacon, in the following passage; " Subjectum istud Medicinæ (corpus nimirum humanum) ex omnibus, quæ Natura procreavit est maximè capax remedii, sed vicissim illud remedium maxime est obnoxium errori. Eadem namque subjecti subtilitas et varietas, ut magnam medendi facultatem præbet, sic magnam etiam aberrandi facultatem." *De Augmentis scientiarum,* liber iv. cap. ii.

† See Elements of Medical Logic. Lond. 1821.

subject, I shall pass to the proper matter of this communication.

Impressed with a high opinion of the advantages derivable to the art of physic from comparative views, I have endeavoured to bring an humble contribution to the medical history of this age and country, by giving some account of one of the largest hospitals in this metropolis, to which I was physician for twelve years; and having kept notes of all the cases that occurred to me during the greater part of that time, and also in my private practice at all times, I propose to submit to this Society some of the principal results of the former from 1784 till 1794, and of the latter from 1795 till 1805.

But with a view to comparison, it will be necessary to carry back our researches into former times; and for this purpose I shall endeavour, from such imperfect lights as professional writings, historical records, and the bills of mortality afford, to make a brief recital of the most remarkable diseases which have arisen, and have since disappeared in this country in the course of time; of those which have arisen but have not disappeared; and also of those which have prevailed with various degrees of frequency and fatality at different periods; concluding with an enumeration of those that have been more prevalent in our times than in former ages.

To the first description belong the leprosy and sweating sickness. The leprosy became general all over Europe in the twelfth century, and was supposed to have been imported by the crusaders. It became extinct, and was again imported into England, but has not been known in Europe, since the beginning of the sixteenth century.

The sweating sickness was supposed to have been imported by the army which invaded England under Henry VII. It prevailed from 1485 till 1551, and in some years during one month in autumn, with a fatality approaching to that of the plague.

To the second description belong small-pox, measles, and perhaps all the other specific contagions, and the venereal disease; and though the exact periods of the origin of each of these cannot be ascertained for want of historical records, there is every reason to believe that there was a time when none of them existed.

To the third description belong the plague, the dysentery, intermittent fevers, typhous fever, the small-pox, the venereal disease, the scurvy, and the rickets. It is doubtful whether the plague ought not to be referred also to the former list, for though it resembles the plague of the ancients in point of fatality, its characters are quite different from those described by Thucydides and other authors, so that it was perhaps generated in the middle ages.

The first mention of the plague in the English history is in the year 430; the last year in which it was epidemic here was in the year 1665, and the last year in which mention is made of it in the bills of mortality is 1679. With regard to dysentery and intermittent fevers, there is the most incontrovertible evidence from the bills of mortality, from professional and other writings, of the great and rapid decline of these diseases. It appears from the bills of mortality, that the annual deaths from bowel complaints, of which dysentery was the principal, fluctuated from one thousand to two thousand, some years amounting to upwards of four thousand in the seventeenth century; that they fluctuated from one thousand to one hundred in the first part of the eighteenth century, and from one hundred to twenty in the latter half of it. And I find, from inspecting those bills for the first ten years of the present century, that the number of annual deaths under this head has been on an average 22.8. The bills of mortality are justly chargeable with great want of discrimination; but the differences here are so wide, and the reduction of numbers so regular, that there can be no doubt of this, as a general truth.

With regard to agues the bills do not afford us satisfactory information, the disease being blended with continued fevers till the beginning of the eighteenth century. In going as far back as the sixteenth century, we learn from Dr. Caius or Keys, the most eminent physician in England of that age, that the mortality from agues in London in the year 1558 was such, that the living could hardly bury the dead. And Bishop Burnet, in his History of the Reformation, speaking of the same year, says, "intermitting fevers were so universal and contagious,* that they raged like a plague." In the next century, we learn from Sydenham and Morton, that intermittent fever was one of the most prevalent and fatal disorders in London from 1661 to 1665, and that for some years afterwards this complaint was very rare. This was probably owing to the greater dryness of the streets, effected by draining, when the city was rebuilt after the great fire of 1666. We are told, however, by Sydenham, that these fevers revived before the end of the century, and were epidemic from 1677 to 1685. They prevailed a good deal during the first part of the eighteenth century. The number of deaths reported in the bills in 1728 is forty-four, in 1729 forty-seven, in 1730 sixteen: they then greatly declined; but we learn from a work of Dr. Fothergill, that they returned in an epidemic form in the years 1751, 1753, and 1754. For more than thirty years past from the date of writing this (1813,) according to my own observation, and the best information I can gather from others, this disease has not been known as an epidemic in this metropolis. In the first ten years of this century (the nineteenth,) the number of deaths under this head in the bills has not been more than four. I was physician to St. Thomas's Hospital, from the year 1783 till 1795, during ten years of that period the whole number of intermittents that fell under my care was 192. As there were three physicians, this may be reckoned the third part of the whole admissions for ten years in an hospital containing 430 patients. I have not noted in my journal from what quarter they came; but my memory perfectly warrants me in affirming, that the great majority of them were labourers from marshy districts, particularly Kent and Essex; and there is this internal proof of the greater part being strangers, that, of the number above specified, only 33 were females. Had they belonged to the resident population, the number of each sex would have been nearly equal. On referring to the notes, which I keep of my private practice, I find that in the course of 25 years, I have met with 63 intermittents. Of these, 12 belonged to the armies, that had served in Holland or Zealand, and of the number affected in England, more than one-half came from the aguish counties. Several of the cases of those who belonged to the resident population, were so slight and irregular, as to render it doubtful whether they were strictly referable to this *genus* of disease.

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* As these are not the words of a professional author the term "contagious" is probably used in a loose sense, intermittent fevers not being contagious; but it is highly probable they were combined with typhus and dysentery, both contagious diseases, as has been remarked in the Dissertation on the Walcheren fever, page 89 of this volume.

The typhous fever, by which is understood that which takes its origin from accumulated filth and want of ventilation in jails, hospitals, ships, the habitations of the poor, and the close buildings of great cities, has probably been in all ages and nations, at least in cold and temperate climates, the most frequent form of continued fever.* But these causes being interwoven with the common habits and occurrences of life, had escaped the observation * of medical authors till about the middle of the last century. The facts relating to this subject were first clearly stated by Pringle and Lind. No example more convincing than this can be adduced of the substantial benefit of the lights of knowledge ; for the measures which have been successfully taken for the prevention of this disease, and which are peculiar to our own times, have been founded on the knowledge of its remote cause.

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* It seems to be a general law of animal nature, at least among the mammalia, that the accumulation and stagnation of the exhalations of the living body produce disease. The glanders of horses arise only in large stables, and the distemper of dogs, in kennels. In the expedition to Quiberon in 1795, several transports, crowded with horses, had their hatches shut for a considerable time in a storm, by which some of them were suffocated; and among the sur-

The mitigation of the venereal disease has arisen from superior habits of cleanliness, and superior skill in the cure; that of the small-pox from inoculation and vaccination.

With regard to the scurvy, by which I mean, a disease having the characters of the sea-scurvy, a considerable mortality is assigned to it in the London bills of the seventeenth century. From the ambiguity of the term, which is loosely applied also to cutaneous affections, we should be at a loss to know, whether it is the sea-scurvy or not ; but in the first place, it is not likely that cutaneous diseases should be liable to so much mortality,† and next, we know from the description which Willis has given of it, that a disease having the genuine characters of the sea-scurvy, did prevail in London in that age, though now entirely extinct. The

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viving horses the contagious disease called glanders was engendered. This is stated on the authority of Professor Coleman of the Veterinary College. During the American war, it was proposed to send live sheep from England across the Atlantic. In a few weeks, in consequence of being crowded in a ship, they all died of a febrile disorder.

* This is founded on the principle stated in the first page of this article.

† The deaths under the head of scurvy in the seventeenth century were seldom under fifty, frequently as high as ninety, and in the year of the plague they amounted to one hundred and five. They declined rapidly at the end of that century, and may be said to have vanished ever since.

scanty supply* of fresh vegetable food for man, and winter fodder for cattle, which made it necessary to slaughter and salt them for winter use; the greater uncleanness and dampness of the streets and houses, accounts for the existence of it in those times. It is now nearly as rare at sea as at land; in consequence of the improved diet, cleanliness, and the general supply of lemon juice in the navy.

With regard to the rickets there is much ambiguity, for though it is first described by Glisson, and though it first appeared in the bills of mortality in 1634, there is great reason to believe, that it existed before that time, and the name of it in the bills is probably blended with other denominations of disease. There is no doubt, however, of the great decrease of it in common with the other complaints of children, which rendered the mortality so much greater among them formerly than at this time.

Accounts have been kept in the bills of mortality since the year 1728, of the numbers who have died at different ages, and it appears that the number of deaths, under two years from that time till 1750, was annually from 9 to 10,000. In the latter half of last century they fluctuated from 6 to 7000; and since the commencement of this century they have averaged under 5,500. This diminution of mortality among children seems imputable to the improvement in ventilation and cleanliness, and to the more judicious management of children, such as greater warmth in apartments and clothing, and the correction of the vulgar error that the exposure of children to the open air at all seasons is salutary, whereas this exposure in the winter and spring months brings on the most common and fatal of all the diseases incident to young children, while this practice prevailed, inflammation of the lungs. It is also highly injudicious to expose children to the open air in the early stage of hooping cough, for it is a catarrhal affection of the lungs, accidentally supervening, which is the most common cause of danger and death in this disease. There can be no doubt that the very great diminution of deaths in this century is partly owing to vaccination.

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* Towards the beginning of the sixteenth century, the art of gardening in England was in so low a state, that Queen Catharine of Arragon could not procure a salad until a gardener was sent for from the Netherlands to raise it. It appears that the most common articles of the kitchen-garden, such as cabbages, were not cultivated in England till this reign.—See Anderson's History of Commerce.

It may here also be mentioned, that in the course of the last and the present century there has been a notable diminution of the number of deaths in childbed. Improved ventilation and purity of air has probably been also the chief cause of this. It is a question how far improved medical treatment has had any share in it; for it is alleged that parturition, being a natural operation, does not require the interposition of art in the human, any more than in the brute creation. This, however, seems more specious than solid; for, the artificial life of the human species, particularly in civilised communities, tends in various ways to thwart pure Nature, and calls for the interference of art; and there can be little or no doubt that the more rational treatment, founded on the improved state of medical science, has had a share in the more favourable results of these cases.

To the other description of diseases, namely, those which are more prevalent in modern times than formerly, belong the scarlet fever, consumption, gout, dropsy, palsy, apoplexy, lunacy, and generally all those diseases of which the brain and nerves are the seat, and of which the increased prevalence in this country in our times, is owing to there being a much greater proportion of the population who live independent of bodily labour than in any former age, and perhaps, something may be ascribed to the general use of tea and coffee. The most recent of these is the *Neuralgia*, or *tic douleureux*, a very severe pain generally affecting the face, the superior frequency of which, since the beginning of this century, has been very striking.

The scarlet fever has been known in all ages. It is described exactly by Paulus Ægineta, and there are several distinct notices of it in the more early modern authors; but in as far as we can gather from the records of physic, it is only in the last seventy years, that it has prevailed epidemically in different countries of Europe and in America. In this country it generally arises and prevails most in seminaries of education; and it is perhaps to the greater extent to which this mode of education has been carried in our times, that we are to ascribe its greater frequency and prevalence, and its being a disease of which subjects under puberty are peculiarly susceptible, is in favour of this opinion. The other diseases under this head, are plainly referable to the increased means of luxury, the improvements in commerce, civilization, and the refinements of life.

The diseases chiefly incident to savage and barbarous nations are fevers,* fluxes, and rheumatisms. One cause of their being exempt from many diseases, is, probably, the loss of all those children in infancy who are weak and sickly, whereas, in civilised times, those who are saved by good nursing and medical skill, become the victims of other diseases in more advanced life. This may be one cause, at least, of the modern increase of consumption.†

But upon the whole, I believe the present generation may congratulate itself on its improved condition with regard to those great sources of human misery, epidemic and endemic disorders.

The remote causes of all predominant disorders may be referred to three general heads, the vitiated exhalations and secretions of the living human body, the noxious exhalations of the earth, and depraved habits of life. The first includes the plague, the specific contagions, typhus, dysentery, leprosy, and the venereal disease ; the second consists of intermittent and remittent fevers ;* the third comprehends palsy and other nervous affections, such as gout, dropsy, scurvy, and rickets.

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* See Rush on the Disease of the American Indians.

† For the proofs of the increase of consumption, the reader is referred to the able and ingenious work of Dr. Woolcombe, intitled, Remarks on the Frequency and Fatality of Different Diseases. London, 1808.

There are many complaints of which we are at a loss to make a comparative statement for want of records. As there are no works, except such as are of a modern date, which profess to give a general account of all diseases, and as there is a great chasm of information in the dark ages, we are at a loss to know whether certain diseases prevailed or not in different periods and countries, and at what exact æra new diseases arose.† It is enough to know practically, that all the three remote causes, namely, contagion, noxious exhalations of the soil, and depraved habits of life, are by their nature very much subject to human controul. This affords us great encouragement in our endeavours to combat them. The counteraction of typhus by means of cleanliness and ventilation; of the small-pox by vaccination in our times; and of agues in the country by the draining of marshes, and in towns by the construction of sewers, and the cleansing of the streets in the seventeenth and eighteenth centuries, are undeniable proofs of the power of human art in preventing and extinguishing diseases. The counteraction of the third class of causes consists in resisting the propensities to sensuality, indolence, and effeminacy, by good moral habits and self-command.

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* The several species of morbid matter generated by the living body, and that which is exhaled from the earth, may be viewed in the light of poisons ; and, as the same person must frequently be placed under the influence of both at the same time, certain modifications and varieties of disease must arise from this combined influence. This might be plausibly illustrated by reference to the nature and causes of several diseases, particularly the yellow fever ; but it would lead into too wide a field of speculation and conjecture to dilate now upon this subject.

† There are obscure notices respecting certain diseases, which make us regret much the great want of medical records in the darker part of the English history. For example: there is a fragment of an Act of Parliament preserved of the 8th of Henry the Second, (A. D. 1162) for regulating the stews, in which it is ordained, among other things, that no stew-holder shall keep a woman who has the perilous infirmity of burning. See *Stow's Survey, v.* 2. *p.* 7. *and Howel's Londinopolis, p.* 337.

The only other important particulars that remain to be noticed, regarding the artificial means of maintaining health in modern times, is the use of linen and soap, the greater facility of procuring fuel, and the more ample supply of water. The frequent change of body-linen was not in common use till the eighteenth century. Soap was not manufactured in London till the year 1554; what was used before that time was brought from abroad or from Bristol, where a coarse sort was manufactured.* There was no regular supply of coals† to London till the reign of Charles the First. It is almost needless to mention, how much an ample supply of fuel is conducive to health, not merely for warmth and for culinary purposes, but as promoting ventilation, which it does not only by the change of air necessarily induced by the current of air up the chimney, but by enabling the poor to admit fresh air in cold weather. It is in the winter season, from want of fuel, that typhous infection is most apt to arise, and also to spread.

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* See Anderson's History of Commerce, and Howell's Letters. Soap is a main article among the resources conducive to human health and comfort. The consumption of it has accordingly kept pace with the incessantly increasing taste for cleanliness, and the corresponding improvement in health. On the 27th of February, this year (1822), a curious and authentick proof of this occurred in the speech of Lord Liverpool, in the House of Lords, on the question respecting Agricultural distress. In order to prove that this distress did not proceed from excessive taxation, producing diminished consumption, but to the excess of the production and importation of corn above what the public necessities required, and the markets would bear, he adduced as one of the instances of encreased consumption, that of soap, which on the average of the years 1787 and 1788, amounted to 292,006,440 pounds; but the average of years from 1819 to 1821, amounted to 643,000,963 pounds. The soap used in manufactures not being taxable, is not included in this statement.

† The prejudice entertained against pit-coal as an article of fuel pernicious to health, was at one period so strong, that a law passed, making it a capital offence to burn it within the city, and only permitting it to be used in forges in the vicinity. The late Mr. Astle,

Those fevers which are generated solely by scarcity and bad food, as in the years 1801 and 1817, after bad harvests, are not infectious according to the testimony of Dr. Bateman, who directed the fever hospitals of London at these periods. That of 1817 was by far the most severe, on account of the poverty of the labouring class from want of employment. All the remote and exciting causes of fever concurred in the calamitous typhus which broke out in Ireland in 1817, for there was not only a failure of the crops of grain and potatoes combined with squalid habits of life, but the summer was so cold and wet that the turf could not be dried for the purpose of fuel; and the same cold and damp weather was also highly unfriendly to health, in a population badly clothed and sheltered. Its ravages were rendered still more extensive by its being incontestibly infectious.

A plentiful supply of water promotes health in a great city, not only by its application to various household purposes, but by cleansing the gutters and common sewers. The original supply of water was by conduits conducting it from the adjacent fields. The water-works at London-bridge were first erected by a German engineer in 1581, but the supply was scanty till the formation of the New River in the reign of James the First. Other sources of supply have since arisen, as the metropolis increased, and

keeper of the records in the Tower, informed me, that he there discovered a document, importing, that a person had been tried, convicted, and executed for this offence in the reign of Edward the First.

the ingenious machinery of the steam-engine has, since the beginning of this century, been applied for conveying and raising it to the tops of the highest houses in all situations, and for extinguishing fires, affording a degree of abundance and accommodation in this article of life hitherto unknown. The watering of the streets is also of importance to health.* The foreigners† who visited England in the sixteenth century, draw a most disgusting picture of the uncleanly habits of the inhabitants of London, and of the filth of its streets. In the reign of Charles the First there was considerable improvement; but it appears from cotemporary English writers, and still more from the accounts of foreigners,‡ that heaps of the most noisome filth were allowed to accumulate in the streets at assigned spots, called laystalls. It appears also, that the streets were then extremely narrow and ill paved, the buildings very crowded, and the sewers very imperfect.§

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* Dr. G. Fordyce was of opinion that the dust of the streets of London was of serious detriment to health, by exciting pulmonic disorders. See *Transactions of a Society for the improvement of Medical and Chirurgical Knowledge, v.* 1, *p.* 252.

† Almost all our information on this subject is derived from foreigners; another proof that observation is suggested by comparison. See Erasmus's Epistles, Hentzner's Travels in England in the time of Queen Elizabeth, Davila's History of the Civil Wars of France, Book 3d.

‡ See Davenant's Works, page 351. London, 1673.

§ The construction of common sewers and the abundant supply of water have no where been more studied, nor better understood, than in ancient Rome. The sewers were so large and magnificent as to be reckoned among the wonders of the world, and founded at a period so remote as cannot be well ascertained by history The salubrity of the city was still farther promoted by Augustus who introduced streams of water into it, as we learn from Pliny. The neglect and destruction of these by the barbarous conquerors rendered Rome extremely sickly, and it became so unhealthful in the twelfth and thirteenth century, that in a deploratory letter of Pope Innocent still extant, it is stated that few of the inhabitants reached the age of forty, and hardly any that of sixty.

It was not till after the Restoration, that those regulations and practices were introduced, which have led to the present salubrity of this city, and to those accommodations and elegancies which are peculiar to this age. It was not merely the rebuilding of that part of the metropolis which was consumed by fire in 1666, on a better plan, which effected the extinction of the plague and the diminution of some other infectious disorders. This was seconded by new and energetic measures, adopted by the legislature* as well as by the magistracy of London, for the removal of filth, the improvement of the common sewers, the widening and paving of streets. It was not till the next century that the cleansing of the streets was still further promoted by the removal of mud, and all manner of offensive substances to the fields, the improved state of agriculture having rendered it very valuable as manure to the cultivators of the land.

It is to the rapid increase of science and natural knowledge, which began in the latter part of the seventeenth century, that we are to ascribe not only this, but many other triumphs over the ignorance,† superstition, and bar-

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* See Statutes at Large, 19th of Charles II. chap. 3, Sect. 20 and 22, and 23d of Charles II. chap. 17: also Acts of Common Council, copied into Hughson's History of London, vol. i. pages 242 and 259 The thinning of the population since that time, must have had the most beneficial effects upon health. It is remarked, in the Parliamentary Report of the enumeration and Parish Registers of 1811, Part II. p. 199, that the population of the ancient City of London had diminished by more than three-fifths in the course of the last century, though the total population of the metropolis had nearly doubled in that time.

† The principal information on these subjects, in the beginning and middle of the seventeenth century, is derived from the writings of Howel and Davenant; and as a proof of the prevailing ignorance and superstition of that age, it may be remarked that the former, though one of the most eminent writers of that time, and historiographer to the King, not only maintains an argument in favour of the existence of witchcraft, but mentions with approbation the numerous trials and executions of the wretched beings accused of that imaginary

barism of former ages; and it must be highly pleasing to every cultivated and well-disposed mind, to contemplate the useful and liberal lights of knowledge, and the energies of industry, advancing hand in hand, lending mutual assistance to each other, and conferring on mankind the most substantial and practical benefits, none of the least of which is the improvement of health.

The fourth general head of causes influencing health are the climate and the fluctuation of the seasons. There has probably been but little change in the temperature of the atmosphere of this island since the ages in which it was overgrown with wood.* But this is by no means certain,

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crime, in 1646. He mentions that the number of them condemned and executed at the Assizes for Essex and Suffolk that year amounted to two hundred. Might not these strange delusions have been properly enough enumerated with the leprosy and sweating sickness, in the list of diseases which have disappeared? Some of those accused of witchcraft, believed themselves to be guilty of it, and might not they, as well as others who believed it, be stated, without a metaphor, as labouring under a species of epidemical insanity, of a piece with the religious and political *mania* with which that age was infected? Dr. Zachary Gray affirms, that he had seen authentic accounts of persons, in number from three to four thousand, who had suffered death for witchcraft in England. The like *mania* prevailed in France in that age. See Voltaire, Dictionnaire Philosophique, article Beker; also a work entitled *Causes Célèbres*, where some horrible enormities of the same kind are recorded, and perpetrated under the sanction of law. Trials of the like nature occurred at Geneva in 1602, and at Wurtzburgh in Germany as late as 1752. The true and only antitode to this malady is the study of natural knowledge, so appositely recommended in those lines of Virgil, familiar to every scholar: *Felix qui potuit*, &c.

* It appears from history that wood, when generally diffused over a country, has a very sensible effect in rendering the atmosphere colder than it would otherwise be. The air being a pellucid body is not warmed by the rays of the sun, except by the effects of refraction not worth estimating, but derives all its sensible heat from the surface of the earth, and it is evident how wood must intercept this operation of nature. See an article in the Phil. Trans. vol. lviii.

there being no records on this subject on which to found a comparison, till the invention of philosophical instruments in modern times. As it is in our power to gratify posterity on this subject, by affording them the means of comparison, it becomes us not to forego this claim to their gratitude.

There are five circumstances belonging to the seasons of this climate which affect health. 1st. It is found that, in a severe winter, a much greater number of aged people die, also of those who labour under chronic affections of the lungs, palsy, and dropsy, and of young children.* 2dly. There is a greater tendency to pulmonic inflammation in the spring months, in proportion to the prevalence of the north-east wind periodical at this season. 3dly. There is greater tendency to *cholera morbus* in the end of summer and beginning of autumn, and this in proportion to the heat of the preceding summer. 4thly. There is a greater tendency to bowel complaints in general during all the autumn months. 5thly. The strength of the wind has an influence on health. Wind is the great ventilator of nature, (and what is artificial ventilation but an imitation of this,) and its effects have, perhaps, not been sufficiently appreciated. It is mentioned in Maitland's History of London, that for several weeks before the plague broke out in London, in 1665, there was an uninterrupted calm, so that there was not sufficient motion in the air to turn a vane. Baynard, a cotemporary physician, confirms this fact; and the like circumstance is mentioned by Diemerbroeck,† in giving an account of the plague at Nimeguen. At the season in which the last plague visited Vienna there had been no wind for three months. It is evident that calms must favour the concentration of human effluvia, particularly in a crowded

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p. 58, by the Hon. Daines Barrington; also Robertson's History of America, vol. i. note 30.

* See Heberden on the Influence of Cold. Phil. Trans. 1796.

† De Peste, l. i. cap. 6.

and uncleanly population; and by the concurring testimony of all authors, it was always among the poor and squalid that the plague made its first appearance, and among whom it was most prevalent and fatal. It seems a well established fact,* that the same morbid effluvia which produces typhus fever, gives a susceptibility or predisposition to the attack of other febrile contagions: and after such diseases have been produced, it is evident how windy weather must retard, and calm weather favour, their propagation, by stagnation and concentration. As the plague existed more or less every year about that time, it is clear that the presence of infection alone is not sufficient to render it epidemic, and that some other cause or causes must concur. These, I conceive, chiefly to have been the accumulation of impure effluvia, favoured by calm weather, and concurring with a certain pitch of atmospheric temperature; for it never appeared as an epidemic but in one season of the year.

During the twenty years which form the period of these observations, the only remarkable deviations from the ordinary course of nature, with regard to the weather, were in 1795, 1799, and 1800. The months of January and February, 1795, were colder than for many years before, or any year since.† Dr. Heberden remarks, that the mortality of January, 1795, exceeded that of January, 1796, by 1352.‡ The mortality of the whole year was 21,179, which is greater than that of any year since, except 1800; or for eighteen years before, except 1793, in which year there was a great increase of mortality from small-pox, and a considerable increase from fever. It appears from the Parliamentary returns, that there was considerable increase of mortality in 1795 all over England.

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* This principle is well illustrated in Dr. Heberden's work on the Increase and Decrease of Diseases, page 94. See also Observations on the Diseases of Seamen, *passim,* and at page 88 of this volume, where an instance occurred of dysentery proceeding from the want of cleanliness and care at Flushing.

† The mean height of the thermometer for these two months in 1795 was 30° 5. The mean height for the same months of the preceding five years was 40° 6. and of the following five years 39°.

‡ Phil. Trans. vol. lxxxvi.

The summer of 1799* was uncommonly wet and cold, and that of 1800 uncommonly dry, no rain having fallen in London from the 4th of June to the 19th of August, except a very few partial showers. In both these years the crops failed greatly, so as to occasion distressful scarcity. The effect of this appears very sensibly, both in the abstract of population, and in the bills of mortality. Though it was a very mild winter, the excess of mortality in the year 1800 over that of the preceding year, namely, 4934, and deducting 600 for the excess of mortality of small-pox this year over the average of the five preceding years 4334, was greater than the excess of the mortality in 1795, over the preceding year, which was only 1938, and adding 437 for the diminished small-pox of that year, it was 12375. This was more particularly observable in the month of January,* so that it would appear that hunger was more hostile to life than cold. The mortality of 1801 was very little above the average, notwithstanding the aggravated distress that might have been expected from two consecutive years of dearth, for the price of corn in these years amounted to double that of former years. The most probable causes of this were, that the most delicate had been carried off the preceding year, the supplies from importation, the encrease of wages, and of charitable contributions. The reported mortality of the whole kingdom that year was 185,970, which is greater than any year in the century, except 1795, in which it was 188,232. The average of the four intervening years was 169,575; so that the mortality of the year of the cold winter exceeded this medium by 18,657, and that of the year of scarcity exceeded it by 16,395. It is evident why the effect of scarcity should not be felt till the year 1800; for the pressure of the short crop of 1799 could only be felt for a short time towards the end of the same year.

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* The mean height of the thermometer this year was 47.9. The mean of five years immediately before and after this year was 50.6, which may be considered as somewhat under the general average of this climate for the year of the cold winter, 1795, of which the mean was 49.7 is included in this calculation, the mean temperature of this climate may therefore be stated at 51°. The mean temperature of the three summer months of this year, was to that of the same months for five years before and after it, as 57.3 to 59.6. All these calculations are taken from the register of Mr. Six's thermometer (which indicates the highest or lowest point during the absence of the observer) without doors, in the Philosophical Transactions. The other thermometer generally reports the means three or four tenths of a degree higher. See some interesting observations on this subject in the 5th vol. of Phil. Transactions of Edinburgh, p. 193, by Professor Playfair. It is a matter of great curiosity, as well as utility, that the temperature of the atmosphere should be recorded in every age, in order to compare the course of nature at different times. The want of the thermometer in ancient times is an obstacle to accurate comparison; but the great and manifest phenomena of nature, as recorded by authors, prove clearly that the cold in the south of Europe was anciently much more severe than in our time. We read of ice on the Tiber; and the weather on the coast of the Black Sea, now a mild climate, was in the days of Ovid as rigorous as that on the shores of the Baltic. Strabo says, that grapes would not grow in Gaul north of the Cevennes, and the rivers of Gaul and Germany were every year frozen over.

There is an observation deducible from these reports, which, though not strictly belonging to this subject, I cannot help stating as a curious and striking proof of the influence of moral causes on the physical condition of man. In the year 1800 and 1801, the number of marriages was considerably diminished in the metropolis, and still more in the kingdom at large, in which the average of marriages for the five preceding years was 67,713; in 1800, they were 63,429; and in 1801, they were 63,840. This was evidently owing to the great discouragement to marriage that arose among the labouring order, from the difficulty of maintaining a family under the scarcity and high price of provisions. The number of baptisms is also considerably under average in these two years, and also in 1802, for an obvious reason. And the marriages in the two years after the scarcity were considerably above the average, in consequence of the marriages that had been deferred in the years of distress.

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* The excess of mortality in that year was owing to what took place in the first six weeks of the year.

There has been no prevailing epidemic deserving of mention, exclusive of small-pox, during this period of twenty years, except an influenza in the spring of the year 1803.

It appears upon the whole, that, except in the case of extraordinarily cold winters, of which only one has happened in the above-mentioned series of years, the fluctuations of the weather in this climate do not much affect health in this age: and this affords a further presumption, that those fluctuations, called by Sydenham constitutions, do not, as he conceived, depend on any mysterious and inscrutable changes in external nature, but on the compound effect of the state of the weather, and the concentration of human effluvia, which was more incident to that age than the present. This last was entirely overlooked by Sydenham, as well as by Mead and Huxham, who lived still later. They referred the whole to the state of the atmosphere, to planetary influence, or to mineral exhalations.

And were we not in so many other instances to see how long the most obvious and useful truths have been overlooked by the most learned and sagacious enquirers, we should think it quite unaccountable how Dr. Short, a physician of great industry and research, who wrote as late as the middle of last century several elaborate works on publick health and mortality, should never once advert to contaminated human effluvia, and imputes but little to bad nourishment, as the causes of epidemics. Ventilation and cleanliness did not occur to any of these authors as the means of promoting public health. But from what has been already stated, can any doubt remain that to these we are indebted for the superior salubrity and the longer duration of life in the present, in comparison with former ages. The sweet sensations connected with cleanly habits and pure air are some of the most precious gifts of civilization. A taste for them tends to give a distaste to degrading and grovelling gratifications; and the common saying that "cleanliness is next to godliness" is founded on reason, inasmuch as it is conducive to moral purity as well as health and pleasure. The blessings of it are not yet so widely diffused in all districts and ranks of Society as they ought to be; and one of the main objects of the author in this dissertation, is to afford to posterity (if he may presume to hope that his humble labours will reach them) the means of appreciating, comparing, and improving upon the present age in matters highly important to the health and virtue, and, therefore, to the happiness of our species.

What has hitherto been said relates to preventive medicine, and it has appeared that in this there is much reason to be satisfied with the efficiency of art. It becomes a question, whether curative medicine possesses equal powers. This will best appear from what remains to be stated in the farther prosecution of the subject.

St. Thomas's Hospital, originally an alm's-house, attached to a convent of Friars; was converted into a receptacle for sick and maimed by King Edward the Sixth, at the Reformation, and endowed, like the other Royal Hospitals, from the spoils of the Romish church. Its funds were greatly augmented by King William and Queen Mary, who are considered as its second founders, and by private subscriptions and benefactions, which began in the same reign, and have continued ever since. It is situated in Southwark, on a tract of ground on the south bank of the Thames, which from Greenwich to Lambeth was originally swampy, and no doubt aguish; but the parts which have been built upon have long lost that character. The soil upon which this and the other ancient parts of the metropolis are built is artificial, consisting of the rubbish of ages, substances which being hard and dry, must be favourable to health. But the situation being flat, and in the midst of a pretty dense population, the perflation is not so perfect, nor the external air so pure, as would be desirable in choosing a site for an hospital. There is accommodation for 433 patients. All the beds are generally full, except ten or twelve, which are reserved for sudden casualties. There were formerly near 500 beds; but in the year 1783, when I was elected physician, febrile infection prevailed so much, that my two immediate predecessors, and one of the surgeons, beside several of the menial attendants, had died in the course of the preceding year of fever caught in the hospital, upon which the number of patients was reduced, and new methods of cleanliness and ventilation were adopted. All the wards have ever since been annually white-washed; the strictest attention has been paid to the cleanliness of bed and body clothes, washing, sweeping, and other means of removing all offensive matter.

Iron bedsteads had been adopted before this time, as less likely to contract and retain infection than those made of wood.

The new methods of ventilation consisted in making apertures at the tops of the windows, for the more free admission of the air. This was done by constructing the upper sash so that it could be drawn down, and by a board playing on a hinge immediately under this aperture, which being generally set at an angle to the horizon of about 45 degrees, prevented the cold air from blowing on the patients.

The main principle of ventilation consists in admitting the fresh air somewhere near to the ceiling; and if an issue is provided for the foul air at the ceiling itself, by means of a trunk carried to a certain height in the open air, and fitted with what is called a cowl to traverse with the wind, the ventilation will be perfect; for the sick are thereby sheltered from direct streams of cold air, and the recent and vitiated exhalations from the living body having, by their warmth, a tendency to ascend, are effectually dissipated. In consequence of these precautions, no medical attendant has since been affected with the hospital fever; nor could I ascribe more than three or four deaths of nurses and patients to this cause during the whole time of my incumbency. It is further to be remarked, that besides the generation and retention of infectious matter from defective ventilation, recoveries in all classes of patients are retarded by impure air.

This is especially remarkable with regard to severe injuries, and the capital operations of surgery. It is a remark of Mr. Howard, in the account of his visitation of prisons and hospitals, that at the hospital at Leeds no case of compound fracture nor trepan survived, till the ventilation of the wards was improved.

At the Hotel Dieu in Paris, so notorious for its filth and bad air, no operation for the trepan succeeded while M. Marceau was chief surgeon, which was fifty years, so that the operation was at last laid aside.*

The like remark may be made with regard to lying-in women and infants. One of the best authenticated proofs of the different influence of foul and pure air is in the Report of the Lying-in Hospital of Dublin. In the space of four years, ending in 1784, in a badly ventilated house, there died 2944 children out of 7650. After improved ventilation, the deaths in the same time, and in a like number, amounted only to 279. If pure air is necessary to preserve the health of the most hale and robust, how much more must it be so, when the powers of nature are weak, or under severe trials? In short, without pure air, the purposes of such institutions would be entirely frustrated. The utmost professional skill, and the most appropriate means of relief, would be unavailing; and not only this essential end, but the secondary, though very important end of hospitals, as schools of experience and instruction, would also be defeated.

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* See Observations sur les Hôpitaux, par M. Cabanis, Paris, 1803, page 180.

There are at this hospital nine wards for men, and six for women, besides two for men and one for women afflicted with the venereal disease.

The number of females who apply, and are admitted, is considerably smaller than that of the other sex. This seems to be owing to the former being less exposed to the exciting causes of sickness, such as cold, fatigue, and intoxication, and also from there being a less proportion of destitute strangers of this sex, as a smaller number of them resort to the metropolis, whether by sea or land.

The portion of cubic space allowed to each person is from seven hundred to a thousand feet. As far as I can ascertain, from my observations on civil, naval, and military hospitals, six hundred cubic feet is the smallest portion of space that ought to be allotted to each person, in calculating the arrangements of an hospital. If it fall much below this, it will be found impossible, consistently with safety from cold, to maintain a due purity of the air.

There were about fifty persons admitted, and about as many discharged, every week. The number of medical and chirurgical patients admitted were nearly equal; but as a smaller number of the latter is discharged on account of the more protracted nature of the cases, the majority of patients actually in the hospital was chirurgical.

The admissions and discharges are made only one day in the week, with the exception of accidents, for which there is at all times ready admission, without petition or recommendation. This regulation is well adapted to the commodious administration of the hospital, and does not seem materially to interfere with the humane purposes of the institution, except with regard to fevers. As the cases of this kind belong to the most indigent and squalid part of the population, it is clear that they are not only the most proper objects of relief individually, but with a view to the protection of the community, and they should be speedily admitted, in order to prevent the accumulation and diffusion of infection. Such cases are always most curable when taken early; and the utmost danger and distress may result to the individual, as well as his family and neighbours, by waiting for the return of the weekly day of admission. Acute cases also admit of more relief, and are a charge to the hospital for a shorter time than chronic affections. I have been told, that there are hospitals in which it is a rule not to admit fevers. It is difficult to conceive what idea the authors of such a regulation could form of an hospital as a beneficent institution, the end of which is the alleviation of human misery. Most probably the dread of introducing infection gave rise to it. If so, I beg most confidently to assure them, from very extensive experience in the public service, that fevers brought from the most infected situations become quite innocuous to those who approach them, provided care is taken, immediately on their admission, to cleanse their persons by stripping and washing them, and cutting off their hair, and provided the hospital is as well ventilated as St. Thomas's has been for many years.

With a view to remedy these defects in hospitals, and to extinguish febrile infection when prevailing in large towns, institutions, called houses of recovery, have been formed in London and other large cities, and they have been attended with the most beneficial effects, particularly in Chester, Liverpool, and Manchester.

The comparative mortality of different hospitals is a most fallacious test of the success of practice, unless the nature and intensity of the several diseases are taken into the account. A large mortality may even be considered as a presumption of an hospital being well conducted, in as far as it indicates that the most severe disorders had been admitted, or, in other words, that the most judicious selection of cases had been made. But, in one and the same hospital, and administered on the same principle, the same objection does not lie, and the comparative statement at different periods may be more fairly admitted in proof of the merits of its management. It is mentioned in some of the old chronicles, that the number entertained in the hospital at its foundation by Edward the Sixth, was two hundred and sixty;* but there is no account of the mortality till 1689, of which year the printed annual report has been preserved;† and it appears that the number discharged in the preceding twelve months was one thousand, six hundred and fifty-four; the number buried, two hundred and three; and the number remaining under cure was two hundred and forty-two. The mortality therefore was about one in ten. The next printed report extant is that of 1721; but the in-patients being blended with the out-patients, in the account of the admission and discharge, no judgment can be formed of the rate of mortality. The number under the head of deaths applies only to in-patients, and that was three hundred and forty. As the hospital had great addition made to its funds at the end of the preceding century and at the beginning of the next, and was about the same time rebuilt on a larger scale, the numbers became nearly double of what they were originally. The annual report of 1741 is preserved in manuscript, in which the in-patients and out-patients are stated separately, and it appears that the number of the former discharged was two thousand four hundred and seventy-one; the number buried, two hundred and ninety-six; and the number remaining, four hundred and forty-six: this makes the proportion of deaths one in 10.9. The printed reports do not state the two classes of patients separately till 1764. There was no increase of mortality in 1740, the year of the great frost, though there was a very sensible increase of it in the community at large, as appears from the bills of mortality. The reason of this, no doubt, is that few of the patients belonged to those classes who suffer from cold winters, that is, the very old, the very young, and the consumptive.

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* See Hughson's History of London, vol. iv. p. 464.

† Since this was first written, I have met with an account of the cures and deaths in St. Bartholomew and St. Thomas's Hospitals in the year 1685, in a work of Sir W. Petty, entitled Political Arithmetic, p. 94. In the former, the number cured was 1764, the deaths 252. In the latter, the number cured was 1523, the deaths 209.

It has been remarked that about the year 1783, some improvements were made with respect to cleanliness and ventilation. In order to judge whether this made any sensible difference in the mortality, I compared the average of the ten preceding years with the same number of subsequent years. I found the former to be in the proportion of one to fourteen, the latter of 1 to 15.6. The average rate of mortality for the next ten years was 1 to 14.2; but in the last ten years, that is, from 1803 till the present year, 1813, it has been 1 in 16.2. The average for the last fifty years, that is, from 1764, at which time the accounts of in-patients and out-patients were kept distinct, has been one in fifteen. The mortality among the medical patients was considerably above the general average, as might naturally be expected from the more fatal tendency of sickness than of injuries and local affections. The mortality of those under my care was in the proportion of 1 to 9.8. In the tables of private practice the deaths are stated under each head; but no inference can be drawn from this with respect to the success of practice, except in the acute cases; for in chronic cases it very frequently happens, that a physician's attendance is broken off, before the termination of the case, whether in recovery or in death.

As both these tables are intended to exhibit the different degrees of prevalence in different diseases in these times, it is necessary to state certain exceptions to this. Neither of these tables shew the fair proportion of small-pox, nor of the venereal disease, nor of lunacy. The first are excluded from the hospital, and in private practice only a small number fall under a physician's care; for the casual small-pox has for many years been almost unknown among the upper ranks of society, who chiefly employ physicians, and the inoculated small-pox is, for the most part, so slight as not to require the attendance of a physician.

The great majority of venereal cases falls under the care of surgeons, both in hospitals and in private practice.

With regard to lunacy, there are hospitals appointed exclusively for this malady, and private practitioners who devote themselves to the care of it, so that only a small proportion falls under the care of general practitioners. The like may be said of child-bed cases.

The hospital tables convey no information with respect to the relative prevalence of children's complaints, nor of consumption, these classes for obvious reasons not being admitted, except as out-patients.

I have placed small-pox in the list of those diseases which have been mitigated in this age. This effect cannot justly be ascribed to inoculation, for it has been satisfactorily ascertained, that the partial benefit of it to those who undergo it has been overbalanced by its favouring the casual propagation of it. But it is fairly due to vaccination, for the benefit derivable from it, whether partial or general, is without abatement or alloy. This subject is fully treated in a subsequent Dissertation in this volume.

By comparing the number of the several diseases in the hospital list with those of the private list, it will be discovered which of them are most prevalent in the different ranks of society. Those which stand most prominent for this prevalence among the lower ranks are intermittent fevers, rheumatism, dropsy, and continued fever. One twentieth of the whole number on the hospital list were intermittent fevers, whereas* only one in one hundred and twenty-two belong to this head in the private list. Rheumatism constitutes one fifth part of the hospital list, but only one twenty-sixth of the private list. One case in nineteen of all the hospital list is a dropsy, but only one in fifty-nine of the private list. The difference here, as well as in the last mentioned, is clearly traceable to the habits of life. It is evidently imputable to the greater propensity of the lower orders to intoxication, particularly from the use of ardent spirits. Neither dropsy of the breast nor of the brain enter into this calculation. Of continued fevers there are about one in eight of the whole number on the hospital list, and about one in eleven and a half in the private list. This may be easily accounted for from what has already been said of the usual origin of continued fevers.

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* In making this calculation, I have subtracted about five hundred

The diseases which stand most prominent for their prevalence among the upper classes of society, are gout, disorders of the stomach, and liver complaints. With regard to gout, there is not a single case of it to be found on the hospital list,* whereas there are in the private list a hundred and thirty, constituting about a twenty-sixth part of the whole. No disease affords so strong a proof of the power of habits of life over health.

Disorders of the stomach constitute about a ninth part of the private list, but no more than a thirty-fifth part of the hospital cases. The reason of this is so obvious, and the fact itself so instructive as to need no comment.

The proportion of the diseases peculiar to the female sex in the hospital, is the same as in the private cases, from which it would appear, that the unfavourable influence of

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from the total amount of private cases; for consumptions and small-pox are excluded from the hospitals, and a number of the catarrhs, children's complaints, and other cases are such as would not have found admission as in-patients of the hospital.

* I remember to have met with a few cases among the out-patients, who I found had either been upper servants in families, or keepers of public houses.

indolent habits, excessive delicacy and sensibility of mind and body in the upper ranks, compensate for the bad effects of hard labour and various privations in the lower orders, producing that equalization of human happiness and misery observable in other aspects of human life.

Of liver complaints, about one in forty-three belongs to the private list, and one in a hundred and thirty-three to the hospital list. This is partly owing to the greater proportion of the better sort, who come from tropical climates, and partly from jaundice and gall-stones, being complaints of more frequent occurrence in sedentary and indolent than in active and laborious life. It appears from the tables, that there is a considerably greater proportion of apoplexies and palsies among the hospital than among the private cases: this is what we should not at first sight expect, and throws a doubt on the commonly received opinion of this disease being more common among the upper than the lower ranks of life. One cause of the great proportion of them among the poor may be, that exposure to cold and wet in their necessary occupations is a frequent occasional cause of it among them, as I found by questioning them at their admission. Another cause of this great proportion of them being found in the hospital may be that these cases are so severe, so sudden and helpless, that they are all sent as speedily as possible to an hospital in the manner of accidents, and this is so true, that at St. Thomas's Hospital, an exception is made with regard to such cases, for they are allowed to be considered as accidents, and are immediately admitted. Some cases of hemiplegia occur in full habits; some in spare and exhausted habits. The former being most incident to the luxurious and indolent, most frequently occur in private practice, and among the upper ranks of life. The latter occur more among the laborious classes, and among such of the rich as are addicted to exhausting pleasures.*

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* See Lecture of Muscular Motion, page 29, read before the Royal Society, 1788, by Gilbert Blane, M. D. F.R.S. and reprinted in this volume.

With regard to the two sexes, there appear to be certain diseases exclusive of those peculiar to each, which are more incident to the one than to the other. The proportion of the total females to the total males in the hospital tables, is not quite two thirds; allowance being made for this, it will appear by inspection, that there is a considerable majority of males under the heads of intermittent fever, pulmonary complaints, bowel complaints, rheumatism, hemiplegia, other palsies and dropsy. The only large head of disease in which there is a majority of females is cutaneous diseases. The cause of the great majority of intermittent fevers in the male sex has been already mentioned at page 120. The reader will readily trace the causes of most of the other differences to the different constitutions and habits of life of the two sexes. With regard to the private cases, the number of each sex is not specified; but I find upon reviewing my notes, that they may be considered as equal. The diseases of which the great majority belong to the male sex, in the private list, are gout, pneumonia, asthma, rheumatism, palsy, especially that form of it called hemiplegia, the other species of palsy being nearly equal. There is a majority of male cases under dropsy, but much smaller than in the hospital list. I find the number of cutaneous cases equal in the two sexes, in my private notes, and am unable to assign any probable cause for the great proportion of such cases among the females at the hospital.

The practical application of these comparative views to the regulation of life, as conducive to health, is too obvious to require comment.

It is very desirable that such views should be made available to the purposes of curative, as well as prophylactic medicine. Let us try whether any useful deductions of this kind can be drawn with regard to the head of disease which stands foremost in the subjoined tables.

Continued fever may be considered as the principal source of mortality, and therefore the most important to be considered; and the first point to be ascertained with regard to its treatment is to satisfy ourselves how far the powers of nature are equal to its cure.

The powers of restoration essentially inherent in the animal œconomy, are perceivable in most diseases, and in none more than in fever. This does not preclude the interposition of art as an auxiliary to the efforts of nature, which are frequently inadequate. The main point to be kept in view is, that no general rule can be applicable to all the variety of ages, constitutions, symptoms, and stages of the disease. In some, particularly young subjects, not vitiated by artificial habits, Nature is equal to the cure: in others, depletion of the vessels and bowels and antiphlogistic treatment are advisable; in others, remedies of a stimulant and cordial nature have been known to save life. If this statement is correct, the perniciousness of all general rules and indiscriminate practice becomes apparent.*

It appears obvious with regard to this and all other diseases, that unless we can calculate with some degree of precision the extent of the powers of nature, we shall find it impossible to assign what is due to them, and what to the agency of medicine in framing our experience with regard to the treatment of diseases; for without such discrimination we may not be able to satisfy ourselves, whether recoveries have been effected by *virtue* of medicine, or in *spite* of it; and from such indefinite and equivocal views, we must frequently run the risk of congratulating ourselves on a great *cure,* where there may have only been a happy *escape.* With a view to resolve this important problem, it would be desirable sometimes to leave nature to her own struggles, as a standard for observation in comparing the result with that which occurs under the use of artificial means.

In the present circumstances of society, practitioners would hardly find it either prudent or warrantable to institute such experiments. Facts bearing on this subject, are most likely to be met with in the infancy of the art, before the discovery of the numerous artificial remedies with which we now find ourselves armed, and which we think ourselves bound to employ. Accordingly, there is to be found, in the very cradle of physic, some highly interesting and satisfactory information on this subject. In the first and third sections of the works of Hippocrates, there are forty-two cases of acute disease, in which the patients are particularised by name, and the symptoms, progress, and termination of their respective disorders, are related with the utmost clearness and the most exemplary candour. Of these, there were thirty-seven cases of continued fever without local affection. In the other five, there was inflammation on vital parts. Of the former, there died twenty-one; of the latter, four. Among the former, are included four cases of child-bed fever, all of whom died; and two, consequent on abortion, both of whom also died. Of the five cases of local inflammation, one was of the brain, one of the throat, one of the lungs, one of the bowels, and one of the liver. None of the subjects of these cases survived, except that of the lungs. The proportion of deaths therefore on the whole number was twenty-five in forty-two. In continued fever without local affection, including the cases of child-bed and abortion, it was twenty-one in thirty-seven; exclusive of these, it was fifteen in thirty-one; and we have seen that, of local inflammations, four died out of five.

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* See this subject fully treated in Medical Logick, p. 183, 2d Ed. Lond. 1821, by Sir G. Blane, Bart.

This statement is extremely instructive as well as curious; for it does not appear that any medical treatment was employed, except glysters and suppositories in a few, and blood-letting in one.

Little notice is taken of air or diet, and only one of the fatal events is imputed to mismanagement. This was the inflammation of the liver, in which it was alleged that the severity of the complaint was owing to the patient not confining himself in due time, and to his having eat animal food and drunk milk during his illness. The only active remedy mentioned in any of these cases, is that of letting blood at the arm in the pleurisy; and this is the only case of inflammation in a vital part which did not terminate fatally.

This record of remote antiquity, while it proves that near one half of those who are attacked with some of the most dangerous diseases incident to humanity may recover by the unassisted efforts of nature, furnishes us certainly, at the same time, with a powerful and triumphant argument in favour of artificial means of relief; for the mortality far exceeds the proportion, not only in the annexed tables, but in any other modern statement with which I am acquainted, at least in temperate climates. It is even greater than the mortality in our tropical fever at Jamaica in 1808: this is stated at 200 in 494.* The rate of mortality, in fever in the hospital, was 1 in 9, in private practice, as exhibited in the annexed tables, was one in seven, and in several cotemporary statements, published by public institutions, it is still less.

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* See Edinb. Med. Journal, vol. v. p. 492.

ABSTRACT OF PATIENTS

Taken in and treated by me at St. Thomas's Hospital, from October, 1783, till April, 1794, with the exception of absences, which amounted in all to six months; so that the whole time was ten years.

Names of Diseases.	Admitted.		Died.	
	Men.	Women.	Men.	Women.
Continued Fevers	288	205	25	29
*Intermittent Fevers	159	33	7	0
Pulmonary Complaints ..	231	90	51	19
†Bowel Complaints	189	75	29	9
‡Rheumatism	547	204	10	3
Inflammatory Sore Throat	15	6	2§	0
Scarlet Fever	1	2	1	1
‖Chronic Sore Throat ..	5	4	1	0
Hemorrhoids	6	11	0	1
Small Pox	18	11	10	2
¶Erysipelas	14	4	1	0
Stomach Complaints	70	40	8**	2
Vertigo, Chronic Head-Ache, and Gutta Serena	46	15	2††	0
Carried forward	1589	700	147	66

* There were eighty-three tertians, sixty-six quotidian, thirty quartans, and thirteen not specified. The deaths were all from dropsy, consumption, and flux.—† Of these there were thirty cases of painter's cholic, none of whom died.—‡ Two of the deaths were occasioned by flux, one by phthisis pulmonalis, one by sudden grief, one by convulsions. There were very few of them acute cases.—§ One of the deaths was sudden, and could not be accounted for; the other was occasioned by phthisis pulmonalis.—‖ Some of these were probably cases of Cynanche Laryngea, with the nature of which I did not become acquainted till afterwards by meeting with them in my private practice.—¶ Many cases besides occurred in the hospital supervening on other complaints.—** One died of concussion of the brain, one of a mortification of the leg, two of pectoral complaints, one of a lientery attended with *aphthæ*.

†† One of the deaths was occasioned by a mortification in the hip,

Names of Diseases.	Admitted.		Died.	
	Men.	Women.	Men.	Women.
Brought forward	1589	700	147	66
Epilepsy	16	17	0	0
Palpitation of the Heart	2	1	0	0
Insanity	2	4	0	0
*Locked Jaw	8	1	4	0
St. Vitus's Dance	7	1	0	0
†Spasms	3	0	0	0
‡Tremors	6	3	0	0
§Hemiplegia	47	21	4	1
‖Other Palsies	48	19	1	0
¶Palsy from Lead and other Metals	7	0	0	0
Dropsy	126	76	44**	33
Jaundice	9	6	2††	1
Inflammation of the Liver	11‡‡	3	4§§	2
Scrophula	35	10	2‖‖	0
Carried forward	1916	862	208	103

after erysipelas in the face; the other was that of a boy with a large head.—* Much benefit seemed to arise from opium, given in a cautious, gradual, and measured manner, also from the warm bath, and from anodyne and stimulant cataplasms. I have seen bad effects from opium, given hastily and to excess.—† One of these cases consisted in general spasms brought on by working in cold clay; another, in painful cramps without any ascertainable cause; the third proceeded from working in lead. ‡ One of these cases was that of a man, in whom it was brought on by working in quicksilver.— §There were more seizures in the left side than in the right, in the proportion of about three to two.—‖ Some were universal, some confined to the upper, some to the lower extremities, some alternate.— ¶ One of these was a worker in brass, five were workers in lead, one became affected by handling printers' types while they were hot.—** One of the deaths was occasioned by the epigastric artery being punctured in tapping.—†† In one of these there was dropsy; in the other, a cancerous affection of the stomach attended with adhesions which obstructed the gall-ducts.- ‡‡ Most of these were from the East-Indies. §§ In two of these, there were abscesses found in the liver: They were both from the East-Indies.—‖‖ One died of a continued fever; the other of a palsy.

Names of Diseases.	Admitted.		Died.	
	Men.	Women.	Men.	Women.
Brought forward	1916	862	208	103
Cutaneous Complaints ...	84	93	2	1*
Sea Scurvy	4	0	0	0
Pemphigus	1	0	0	0
Opththalmia, Lippitudo and Leucoma	15	5	1†	0
Diabetes	2	0	0	0
Other Urinary Complaints	39	15	3‡	2
Venereal Complaints	137	65	1	2
Hydrophobia	2	0	2	0
Hydrocephalus	1	0	1	0
Tape Worm	0	1	0	0
Diseases peculiar to Women§	0	256	0	18
Anomalous, obscure, and complicated cases	205	132	21	9
Total	2406	1429	239	135

ABSTRACT OF CASES

Occurring in private practice, from 1795 till 1806.

Names of Diseases.	Number of Cases.	Deaths.
Continued Fevers........................	267	38
Intermittent Fevers	25	1
Pulmonic Inflammation	145	25
Phthisis Pulmonalis	129	65
Spitting of Blood	36	3
Catarrh	271	0
Asthma	63	1
Hoarseness	9	0
Carried forward	945	133

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* She died of a bad ulcer.—† This death was from continued fever.—‡ One of these deaths was from continued fever.—§ One of these was a case of menses occurring periodically from the navel.

Names of Diseases.	Number of Cases.	Deaths.
Brought forward	945	133
Hooping Cough	31	5
*Palpitation of the Heart and Angina Pectoris	21	4
Aneurism of the Aorta	1	1
Rheumatism of the Thorax	3	0
Anomalous Cough	3	0
Abscess of the lungs from old injuries	2	1
†Ossification of the Trachea	2	2
Peripneumonia Notha	10	1
Rupture of the Heart	1	1
Chronic Inflammation of the Larynx	1	1
‡Sudden and severe pain of the Pectoral Muscle of one side	1	0
Loss of Appetite, Acidity and Flatulence in the Stomach	118	0
Carried forward	1139	149

* In one of these cases there was an extreme distress of breathing for five years, and the pulse fluctuated from twenty to thirty-two, never falling below the former point, nor exceeding the latter. Nothing gave material relief. Leave was not obtained to open the body after death.—One was cured by mercury, digitalis, and arsenic.—† These cases ought rather perhaps to have been stated as chronic inflammations of the *trachea*. In one of them there had been frequent tedious untractable catarrhs, for many years attended with a peculiarly sounding cough, and difficult expectoration, the necessary consequence of the rigid state of the *trachea;* for there are certain muscles composing the soft part of that tube, for the purpose of contracting its area, by the coarctation of the cartilaginous rings, in order to give greater *impetus* to the expired air in expelling redundant secretions, morbid matter, or extraneous substances. It is evident that this cannot be done where the rings are ossified. In the other case the symptoms were more distressing, for the dyspnæa was so severe, that the patient sometimes seemed strangled, and dropped down in a state of insensibility. Besides the ossification, there was found in both some portions of the lungs, of a consistence preter-naturally dense, from bloody serum effused in the cells; but this was much more extensive in the second case, which accounts perhaps for the more severe sufferings.—‡ Cured by bleeding and antiphlogistic treatment. The blood was sizy.

Names of Diseases.	Number of Cases.	Deaths.
Brought forward	1139	149
Hypochondriasis	57	0
Acute Pain of the Stomach	92	0
Laborious Digestion	2	0
Vomiting of Blood	10	0
Vomiting and Nausea	43	1
Inflammation of the Stomach	6	2
Water Qualm *(Pyrosis)*	12	0
Cancer of the Stomach	3	3
* Inordinate Appetite	1	0
Dull Pain of the Stomach suspected to be Rheumatic	1	0
Inflammation of the Bowels	29	6
Dysentery	38	5
Cholera Morbus	67	4
Ileus	4	0
† Diarrhœa	101	5
Colic	12	0
Intestinal Hæmorrhage	30	0
Piles	27	0
Cœliac Passion	6	2
‡ Obstructed Mesentery	94	2
Flatulence of the Bowels	4	0
Constipation	9	0
Lientery	1	0
Ulceration of the Bowels	1	1
Fecal Congestion	2	0
Griping Pain and Diarrhœa after meals	1	0
Painter's Colic	2	0
Palsy of the Bowels	1	1
Acute Rheumatism	44	1
Chronic Rheumatism	75	1
Gout	130	7
Rheumatic Gout	5	0
Common Sore Throat *(Cynanche Tonsillaris)*	51	0
Quinsy *(Cynanche Pharyngea)*	11	0
Carried forward	2111	190

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* This case was attended with the hallucination of a live animal being in the stomach, and terminated in mania.—† A considerable number of these were children.—‡ These were chiefly children.

Names of Diseases.	Number of Cases.	Deaths.
Brought forward	2111	190
Mumps *(Cynanche Parotidea)*	3	0
Bronchocele	2	0
Croup *(Cynanche Trachealis)*	3	0
* Cynanche Laryngea	3	2
Chronic Thrush	1	0
Angina pustulosa	1	0
Lumbago	2	0
Sciatica	3	0
†Chronic Headache	39	1
Vertigo	28	0
‡ Mania	24	2
§ Epilepsy	16	2
Hemiplegia	36	19
Local Palsies	19	0
Paraplegia	4	0
Palsy from Lead	1	0
Catalepsy	2	0
Inflammation of the Brain	3	2
Lethargy	3	0
Tinnitus Aurium	5	0
Intolerance of Touch on the whole skin	1	0
Hemicrania	3	0
Neuralgia, or Tic Douleureux	4	0
Gutta Serena	1	0
Tremors	3	0
Carried forward	2321	218

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* One of these was an acute case, and ten years afterwards the same complaint returned in Ireland, and proved fatal; being the same individual whose case is related in Med. Chir. Trans. vol. iv. by Dr. Percival I have since met with three chronic cases, all which proved fatal, after a long series of suffering from threatening suffocation. Two of them were inspected after death, and *pus* was found in all the interstices of the muscles and bones of the larynx, the organization of which was considerably impaired.—† See the fatal case related in the Transactions of a Society for the Improvement of Medical and Chirurgical Knowledge, Vol. II. Art. 16.—‡ See one of the fatal cases related, *ibid.*—§ In one of the cases, which proved fatal, the epidermis of the feet and hands came off from time to time in form of a glove.

Names of Diseases.	Number of Cases.	Deaths.
Brought forward	2321	218
[*] Excessive Sensibility to Cold	2	0
Convulsions	8	2
Poisoned by Opium	1	1
[†] Chronic Suppuration of the Frontal Sinuses	1	1
Spasms	4	0
Raphania	1	0
Spasms of one side of the Neck	3	0
Small-Pox	15	3
Measles	32	3
Scarlet Fever	39	10
Chicken-Pox	2	0
Swine-Pox (Pemphigus)	1	0
Erysipelas	91	2
Cow-Pox	8	0
Inflammation of the Liver	15	1
Jaundice	25	2
Obstruction of the Liver	12	1
Gall-Stones	12	2
Redundant Secretion of Bile	5	0
Vitiated and Redundant Secretion of Bile	2	0
Swelled Spleen	1	0
Inflammation of the Kidneys	9	1
Stone and Gravel	48	1
[‡] Dysuria and Ischuria	20	0
Diabetes	5	1
Scanty Urine	1	0
Irritable Bladder	1	0
Ulceration of the Bladder	3	1
Carried forward	2688	250

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[*] In one of these there was no other symptom of indisposition; in the other there was a rheumatic affection. The first was treated with chalybeates, opiates, and strong aromatics, under which he recovered. The other was treated with arsenic, and recovered under the use of it.—[†] The matter was discharged by the nose. After fifteen years, there came an irregular hemiplegia and stupor, and at last proved fatal.—[‡] One of these was a case of *Ischuria renalis,* of alarming severity, and was removed almost instantly by the application of electricity.

Names of Diseases.	Number of Cases.	Deaths.
Brought forward	2688	250
Incontinence of Urine	2	0
Bursting of the Urethra in Perinæo	2	1
Impotency	3	0
Emissio inconscia Seminis	2	0
Priapismus sine Libidine	1	0
Gonorrhœa Benigna	2	0
Excess of Venery	3	0
A peculiar species of Hectic Fever from Irritation of the Urethra*	3	3
Fluor Albus	46	0
Hysteria	97	0
Obstructed Menses	67	1
Profuse Menses	43	0
Scanty Menses	23	0
Pale Menses	5	0
Uterine Hemorrhage	1	0
Painful Menstruation	5	0
†Flatus per Vaginam	1	0
Vomiting of Blood, vicarious to Menstruation	3	0
Irregular Periods of Menstruation	3	0
Extra Uterine Fœtus	1	0
Cancer of the Womb	7	4
Cancer of the Mamma	4	2
Child-bed Fever	1	1
‡ Chlorosis	23	0
Induration of the Os Uteri	3	0
Cancer of the Mouth	1	1
Venereal Disease	32	0
Ascites	23	11
Anasarca	28	0
Hydrothorax	37	14
Carried forward	3160	286

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* This was brought on by the repeated application of caustic, acting on infirm and irritable constitutions.—† A communication between the rectum and vagina had been produced by ulceration.—‡ One of these was a male of seventeen, who had all the characters of this disease, except that which is peculiar to the female sex. He was treated like the others, and recovered under the use of carbonated iron and aloes.

Names of Diseases.	Number of Cases.	Deaths.
Brought forward	3160	286
Hydrocephalus	15	11
Dropsy of the Ovarium	2	0
Encysted Dropsy of the Groin	1	0
Impetiginous Affections	160	0
Carbuncle	3	1
*Shingles	5	0
Petechiæ sine Febre	2	0
Spontaneous Gangrene	1	1
Pruritus Pudendi	2	0
†Sea-Scurvy	4	0
Nettle Rash	1	0
Scrophula	37	2
Rickets	4	0
Teething	2	0
Ophthalmia	15	0
Lippitudo	2	0
Excessive Secretion of Tears	1	0
Deficient Secretion of Tears *(Xeropththalmia)*	2	0
Tape Worm	3	0
Lumbrici	2	0
Ascarides	12	0
‡Old Age	5	4
Anomalous, Obscure, and Complicated Cases	375	77
	3816	382

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* In one of these cases, the patient, after recovery, was for the remainder of her life, which extended only to a few years, almost incessantly tormented with a severe pain in the abdomen, in which nothing gave relief. On inspecting the body after death, it was found that immediately under the spot on the right side of the abdomen, which had been the seat of the shingles, and to which the subsequent pains had been referred, adhesions had taken place, and no doubt remained that these pains had been occasioned by the mechanical dragging of these attachments.—† In none of these cases, except one, was the disease occasioned by a life at sea, but arose from some peculiar propensity of constitution, under ordinary diet and habits of life. They were all cured by lemon juice.—‡ The most common symptoms characterising the disease of mere old age were frequent rigours, frequent and long-continued jactitations, producing a state of considerable suffering, and wearing out of the residue of life, by a sort of hectic fever. Their ages were from 80 to 99.

DISSERTATION V.

Remarks on the comparative Health and Population of England at different Periods.

Many countries surpass England in the mild and equal temperature of their climate, and in the natural fertility and superior productions of their soil. But it would not be difficult to prove that the strenuous exertion of mind and body called forth to counteract this apparent unkindness of Nature, have been the essential causes of that superiority of character which distinguishes the inhabitants of this island, as well as of that pre-eminent power, prosperity and happiness which they enjoy.

The four great necessaries of life are food, clothing, shelter and fuel; and it is to the skill and labour which the climate of England renders indispensable for the procuring the three first of these, that those habits of industry and hardihood are acquired which are equally conducive to virtue, intelligence, and health. It is truly said, that under all the disadvantages and vicissitudes of our rains, fogs, and frosts, there are more days in the year in which a person can go abroad with satisfaction and comfort, than in the south of Europe, where the atmospheric heat confines people to the house, the greater part of the day, for a great part of the year, while we are in the full enjoyment of the healthful delights of the open air, and even disregard the fervour of the sun-beams from which they shrink. Nor do we find ourselves under the necessity, like the Russians, to contrive such a system of guarding against cold in winter, as to induce habits of tenderness and effeminacy even among the lowest ranks. In the year 1797, a squadron of Russian ships of war wintered in our ports, and having become sickly, I visited them officially in order to make arrangements for their treatment and accommodation. I found that their unhealthy state proceeded chiefly from cold, and that their extremities were frost bitten, that is, fell into torpidity and gangrene, from a degree of cold from which the British seamen felt no inconvenience. Had they been in their own country at this season, they would have been out of the reach of cold, in close and warm habitations under ground.

What an ascendant, then, do the natives of the British isles, as a military nation, possess over their neighbours and rivals in the north and south, in being able thus to endure the extremes of heat and cold better than the natives themselves of those respective countries, as has been historically and practically proved! For, is it not ascribable to this that they have outstripped their antagonists in the race of arts and arms in all climates, pushing the pursuits of war, commerce, and science in the five zones, to the utmost verge of the habitable earth, and the navigable ocean?

The first, and principal class of the necessaries of life above enumerated is food, the sources of which are pasturage, agriculture, horticulture, and fisheries. In an economical and political, as well as medical view, the several species of it may aptly be classed under three heads; the animal, consisting of land and water animals; the farinaceous, consisting of the grains, potatoes, and some other roots, and the production of the garden, consisting of roots, fruits, and greens.

It is providentially ordained that the chief subsistence of this and other civilised nations should consist of the productions of agriculture, for this branch of industry is of all other employment, the most conducive to virtue and health, and the productions themselves are, of all others, the most salutary.

It is essential to human happiness that food should be the reward of labour, even hard labour. If man were to be sustained by the spontaneous productions of the earth, it is manifest that none of the faculties either of mind or body could ever have been developed, nor hardly could any of the moral or intellectual attributes of his nature have been said to exist; in short, he would, in the scale of the creation, have been raised but a little above the brutes.

A valuable accession has been made to our stock of farinaceous food in the last hundred years by the introduction of potatoes. In the degree in which they have been cultivated in Great Britain, there can be no doubt of their having added to the substantial comfort of the people, and even to their numbers. But in a sister kingdom, it is to their operation, as the main constituent of national sustenance, that her population has advanced from little more than one million to near seven millions in the last hundred and fifty years.* With all this advantage, serious objections have been raised to this species of food in comparison and contrast with that of the grains. It is alleged, First, That the cultivation of this salutary and nutritious root demands so small a portion of time and labour in comparison of the grains, that a habit of sloth is engendered incompatible with happiness, dignity, and virtue, so as to make an approach to the evils of spontaneous food; Secondly, That this great facility of procuring adequate food, so far out-runs the acquirement of other two necessaries of life, clothing and shelter, as to leave the people in the depth of degradation and misery ;* Thirdly, It is alleged that this species of food differs from the grains in this important respect; that it is of so perishable a nature, that it hardly extends round the year, and far less can the abundance of one year be brought in aid of the deficiency of a following year, in which a mortal scarcity may occur from the failure of a crop. Lastly, That the whole of these allegations are practically and deplorably proved by the physical and moral evils most lamentably prevailing in Ireland at this moment (June 1822) particularly in the south-west districts of that kingdom, where an actual famine rages.

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* Sir William Petty estimated the population of Ireland at 1,100,000 in 1672. See his Political Anatomy of Ireland, page 17; and from late estimates, it appears that it is little short of the number stated in the text, so that the population of that kingdom encreased nearly as much in 150 years as England had done from the Norman Conquest to 1821, as will appear by what follows.

Though this article of subsistence, therefore, has proved an incomparable benefit to England, she will act wisely in continuing to use it to a limited amount, by employing it as an invaluable auxiliary and substitute, but by no means as a staple article, far less as an exclusive constituent of national subsistence.

I have said, that in a medical, as well as in a political and economical view, farinaceous nourishment is pre-eminent over the other classes. In the regulation of diet for the sick, animal matter is too highly alimentary, stimulant, and putrescent, and the *olera*, as well as the greater number of roots and fruits are flatulent, acescent, of more difficult assimilation, and too low in the scale of nutrition.

In the rude ages of English society we find that animal food formed a much larger proportion of the general stock of subsistence than in modern times, for, pasturage requires but little skill or intelligence in comparison of agriculture. It appears from an act of Parliament as late as the reign of Henry VIII., that beef, veal, and pork, were considered as the ordinary food of the common people; for the object of the act being, according to the false policy of that age, to regulate prices by law, the prices of these articles of animal food were set at no more than one twentieth, whereas the price of wheat was set at one tenth of that of the present times. There is one objection to so large a proportion of animal food, that as there was then a very scanty provision of winter provender, it was necessary to preserve it by salting, which was productive of scurvy; and another on the score of policy, for pasturage requires fewer hands to carry it on, particularly when there was only natural pasture, and when the food of cattle was not, as now, provided by agriculture. Pasturage also occupies so large a surface of the soil, that it does not leave sufficient space for tillage, and is, therefore, incompatible with a numerous population.* The only substantial objection to the grains is, that the production of them is dependant on the vicissitudes of the weather; for, all the dearths and famines, which did not cease till the middle of the fifteenth century, were owing to the failure of crops from bad years. And these natural and unavoidable calamities were greatly aggravated by the ignorance and impolicy of the legislators of those ages, who laid restraints on that commerce of grain whereby the distress from scarcity in one district, or country, might have been relieved by the abundance of another, and also by the fixing of prices, and the persecutions and obloquies heaped on the dealers in grain who were accused of monopolies and forestalling, purely imaginary, as if the distress had proceeded from them and not from natural causes. The improvements in agricultural skill, the progress of knowledge, and better policy, have had their share in preventing any recurrence of famine since the year 1448. But what has had by far the greatest share in the averting of famine, has been the production of a quantity of corn beyond the bare necessities of the consumers. It is self-evident that if in years of ordinary plenty there is just enough, and no more, produced than will sustain life, every year of scarcity must prove a year of famine. In simple ages, there are no motives for producing more than what the wants of nature require. But as refinement and the arts of life advance, a demand arises for horses, fermented liquors, and the various artificial wants of luxury. This operates virtually as a perpetual granary, so that when a year of scarcity arises the resources of superfluity may be turned into the channels of necessity. To this, and the free commerce of grain, we owe our long exemption from famine in England.

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* There is an exception to this in the province of Ulster, where the profits of manufacturing industry enable the peasants to purchase the means of subsistence from distant parts when it fails among themselves. Corn is also more cultivated in the North-eastern district than in the rest of the kingdom.

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* The only exception to this that occurs to the Author's recollection is Holland.

It would be an inexcusable omission in treating on this subject not to advert to over population, as one of the causes of famine. This is no where so strikingly exemplified as in China. It is considered as a religious duty and a point of honour in that country for young persons to engage in marriage as soon as they are marriageable, celibacy being deemed disreputable. The consequence is, that the whole business of life among that nation is a painful and debasing struggle, or scramble as it were, for the means of subsistence. The direful practice of infanticide has, therefore, been the means to which this nation has ever had recourse, for keeping down the population to the means of subsistence, but from the reluctance to such an outrage against the natural feelings, this is inadequately practised; and the latest and the most authentic travellers assure us that there is not a year passes without more or less famine in some of the provinces of that Empire.*

This seems strongly to favour the doctrine of Mr. Malthus, which consists merely in the maxim, that there cannot and ought not to be more human beings in existence than can be fed, and that without some restraint put by reason on the procreative appetite, the multiplication of the species would be such as soon to out-run any corresponding and practicable multiplication of subsistence. It is true that man is endowed with instinctive propensities in common with mere animals, and that it is conformable to nature that he obey them; but it is equally conformable to his pre-eminent *nature,* as a rational being, that he control these propensities, of which the unbridled indulgence would plunge himself and his offspring into vice and misery. It is in fact, therefore, a thwarting of Nature properly understood, in the Chinese, to give way to superstition, sensuality and capricious practices, in place of listening to the dictates of reason and prudence.

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* See Barrow's History of Lord Macartney's Mission.

It has been practically proved in America,* that if the physical powers of procreation were to be exerted to the utmost by early marriage, the species would double in less than twenty years. Say twenty years; and let the population of England and Wales be taken at twelve millions, to which it closely approaches by the enumeration of 1821, and let the population of the whole world be assumed to be twelve hundred millions, it will be found, by a simple operation of arithmetic, that by doubling every twenty years, the population of this part of the island would exceed that of the whole human species now in existence in little more than a hundred and thirty years. It is evident, that by no exertion of human industry, operating on the highest fertility of soil, could subsistence keep pace with these seven steps of progression for more than one step, or two at the farthest. In the nature of things, therefore, some check must be found to the headlong propensities of animal nature, and that a check founded on prudence is better than the dreadful corrections of infanticide, famine, or disease. For though this doctrine is founded on a principle, which is so simple and undeniable, that, at first sight, it seems little better than an insipid truism, namely, that there cannot, and ought not to to be, more human beings in existence than can be supplied with food, yet Mr. Malthus has been pretty severely reprehended for broaching it, as if he meant to recommend a tyrannical restraint on the most natural propensities and gratifications of our nature. On the contrary, it appears to me, that the doctrine is in perfect accordance with that principle, which has dictated the expediency of marriage itself, as an artificial bar to promiscuous and licentious indulgence, and which has entitled chastity to be ranked among those virtues which dignify human nature, and indispensable to the welfare of mankind. If I were to criticise the work of Mr. Malthus, I should say, that in his various reasonings, equally ingenious and solid, he has not laid sufficient stress on the other, though subordinate necessaries of life—clothing, habitation, and fuel; and perhaps he has not stated, in terms sufficiently strong and explicit, the importance of *employment*, as an elementary principle in questions of political economy. It may also be doubted whether he has allowed sufficient scope for the powers of *emigration* in the present uncultivated state of a large proportion of the fertile surface of the earth. He has indeed ably stated the alarming evils likely to arise out of an inordinate preponderancy of manufacturing over agricultural industry. But who could foresee the present novel, and unexampled state of things in which evils have arisen from the want of employment, which had till now been considered as exclusively ascribable to deficiency of food! No such deficiency has taken place, for the production of corn has kept pace with other manufactures, and with the encreased population. This excess of production is demonstrably true with regard to manufactures, as is evinced by the supply having gone so far beyond the demand a few years ago, as to throw thousands of workmen out of employment, and to glut the markets of the world. This is not so fully admitted with regard to corn; but certain it is, that the encrease of domestic production has been such as to supersede that foreign supply, which was absolutely necessary for national subsistence in the end of the last, and the beginning of this century, for a law for excluding it was passed in 1815, in order to protect the domestic growers.* Notwithstanding this, the quantity has been so great, that, combined with the encreased use of potatoes, and the importation of grain from Ireland,† the utmost distress has been brought upon the landed proprietors and farmers of England. This is the more extraordinary, as it appears from the late census, that there has been a great increase of population in the last *decennium.* The diminished consumption from want of employment takes off a little from the effect of this. It has already been observed,† that this diminished consumption from want of employment appeared to have contributed to the growth of typhous fever; so that a certain proportion of the population might be said to have been almost starving in the midst of plenty.

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* See the authorities for this quoted in Mr. Malthus's Essay on Population, p. 338-9. 2d Ed.

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* It was stated in the luminous speech of Lord Liverpool on the 26th of February last (1822,) that the importation from Ireland had been rapidly encreasing, and that it had amounted in the preceding three years to more than the former importation from all Europe.

I am well aware that other causes‡ have been assigned for the fall of the price of corn and the consequent agricultural distress, but it would be out of place here to enter at length into such intricate discussions. I shall confine myself to one other remark on the doctrine of Mr. Malthus, as having some relation to professional duty. For if it is true that population must be limited by the stock of subsistence, and that the physical power of procreation is adequate, not only to uphold population at all times as high as the stock of subsistence will bear; but, from the indefinite extent to which it may be carried, to repair, in an incredibly short time, the utmost ravages of disease; it seems to follow that such a saving of human life as is within the reach of vaccination, or any other medical means, can be of little value to the great interests of society. To this I would answer, that, though I am well convinced that these principles* are founded in truth and nature, and that properly understood and applied, they have a beneficial tendency, and may

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* The principle of this act, with regard to wheat, was, that the ports should be shut against the importation of it, while its average price was below 80*s* They remained shut till the end of 1816, when, in consequence of the very scanty and bad crop of that year, the price rose above that, and the ports were opened, and continued so, with exception of a few weeks, till February 1819. Since which the price has continued falling, and is now (June 1822), 45*s*.

† See page 126.

‡ The other causes that have been assigned for agricultural distress, besides the immense encrease of cultivation, the Irish importation, and the encreased consumption of potatoes, have been the transition from war to peace, high taxation, the reduction of the quantity of currency, and parliamentary corruption. Though it appears to the author that no markets can be essentially affected, but through the law of supply and demand, he will not, in contradiction to opinions which he ought to respect, deny the subordinate influence of other causes. But in answer to those who ascribe so much to the transition from war to peace, he begs them to recollect, that it was in the year 1813, when the war was at the height, that the corn fell

from 5*l.* 19*s.* to 3*l.* 12*s.*† and was as severely felt in 1814,‡ also a year of war, as it has been ever since: in answer to those who ascribe so much to taxation, he begs to remind them, that eighteen millions of taxes were remitted in 1815, and still more since, without the least relief to agriculture, and if this were the cause, the distress would not be confined to agriculture; nor will it account for the like distress existing in other countries on the continent of Europe, particularly Swisserland, and in the American States: and to those who lay so much stress on the reduction of currency, he begs to submit to their candour, without denying that it has considerable effect, that when the distress first took place, that is, in the years 1813 and 1814, the circulating medium was at a height, of which there has been no example in any age or country: to those who allege that a reform of Parliament is the only cure for this evil, he addresses himself with less diffidence, being well convinced, in common with all men of good sense, whose opinion he has heard on the subject, that those who broach and propagate this notion, do so, either from ignorance and a perversion of understanding, or for factious purposes.

* See Essay on Population by Mr. Malthus.

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† See London Gazette for 9th of January and 13th of December, 1815.

‡ See Reports of Speeches in Parliament on the Corn Bill.

safely be admitted as maxims of political science, it is, nevertheless, equally well founded in truth and nature, as a principle of moral science, that the dependence of individuals on each other is such, that neither social institutions, nor even the human species under any form, could exist without the operation of the kind affections, and of practical beneficence, which are, at the same time, the main constituents of all that is understood by the name of virtue, and of whatever is amiable and excellent in the human character. It seems, therefore, hardly necessary, and almost impertinent, in addressing men of cultivated minds and correct principles, such as those who compose the professions of physic and surgery, to refute the fallacious reasoning abovementioned; and to remark that it is our paramount duty, and ought to be our unceasing study, to preserve the lives, and to alleviate the sufferings of all those who seek our assistance.

In the slowly progressive amelioration of the state of society in England, we were more than two hundred years later in getting rid of pestilence than of famine. Though these two calamities are frequently combined, they also frequently occur separately. The plague was most frequent, universal, and destructive in the fourteenth century. It spread from the north-western parts of Asia over all Europe, and reached England in all its horrors in 1349. The whole of the kingdom was infected. In some parts, two-thirds or more of the inhabitants were carried off, but, on an average, one-half was computed to have perished. There are sufficient proofs of its having been imported, though it has been thought by some to have been engendered by squalid habits of life, combined with scanty and bad food, for it always made its first appearance among the poor. But the more natural explanation of this is, that the noxious effluvia generated by these habits, and the weakness of body and depression of mind induced by the scanty quantity and bad quality of food, creates a predisposition or susceptibility to noxious impressions. There can be little or no doubt, that in the immensely multiplied degree of commerce in this age, the infectious matter of plague has been imported by sea to London from the Levant, but that the spark has failed to light up the flame of pestilence as formerly, for want of the requisite fuel.

It has been explained in the preceding Dissertation, how much health has been improved by the improvements in clothing, habitation, and fuel. It appears that in very rude, and almost savage times, the diseases arising from want of cleanliness and ventilation were less prevalent, than in what may be called the semi-barbarous ages. In the former, the modes of life are so simple, as not to exclude fresh air, nor to harbour that filth on persons and in habitations which produce typhus and dysentery, and which invites the plague. In the progress of civilisation and refinement, this is obviated by a taste for cleanliness and decency. It is remarked by Dr. Macculloch, in his account of the Hebrides, that while the inhabitants had no shelter but huts of the most simple construction, which afforded free ingress and egress to the air, they were not subject to fevers; but when, through the good intentions of the proprietors, such habitations were provided as seemed more comfortable and commodious, but which afforded recesses for stagnating air and impurities, which they had not the means, or wanted the taste for cleanliness to correct, then febrile infection was generated. To the same purpose we might quote an analagous remark made by Dr. Robertson, regarding the moral habits of the European nations in the middle ages.* It was no doubt owing to improvements in the modes of life, that the plague of 1665 did not become epidemic beyond the metropolis, nor affected the upper classes of society.†

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* See Preliminary Discourse to the History of Charles V., ch. v. sect. 1.

† See Lord Clarendon's Life, written by himself.——There is historical proof of the plague having been twenty times epidemic in London, from the year 1572 to 1665.

There are records of some severe epidemics besides the plague in past ages in England. The sweating sickness has already been mentioned; and also the severe epidemic of 1558; but it may be farther remarked, that this last spread all over England, and seemed to be connected with the weather, for it was a year of great floods, affecting the harvest, which was rendered still more scanty by the want of hands to gather it in, on account of the sickness and mortality, Dr. Short, in his Comparative History, mentions, that this intermittent fever was attended in many cases with a dysentery.

The observations relating to the salubrity of different districts of England, are taken from the Parliamentary returns of 1811. The counties in which the mortality was above the average, were Middlesex, where it was 1 in 36; Kent, where it was 1 in 41; Warwickshire, where it was 1 in 42; Cambridgeshire, where it was 1 in 44; Essex, where it was also 1 in 44; Surrey, where it was one in 45; the East Riding of Yorkshire, where it was 1 in 47; Lancashire, where it was 1 in 48. Of these eight counties, four are subject to agues, namely, Kent, Essex, Cambridgeshire, and the East Riding of Yorkshire, comprising all the counties of that description, except Lincolnshire, in which the mortality was below the average, for it was 1 in 51, the average being 1 in 48.7. The smaller degree of mortality in this last, is no doubt owing to the great proportion, which the dry and upland part of this county bears to the fenny districts. That there is a great difference in the mortality in these, is proved by their respective returns. The mortality in the town of Boston, for instance, which is situated in the fens, is 1 in 27; whereas that of Stamford, which is in the dry and upland division, is 1 in 50.

And here it may be proper to advert to an observation, grounded on a very satisfactory induction of facts, in a tract lately published, of which Dr. Wells is the author,* that

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* This tract is an article in the third vol. of a work, entitled Trans-

Phthisis Pulmonalis is but little known in those districts which are infested with the exhalations producing intermittent fevers. But as this disorder forms one of the principal heads in the general mortality of England, so much the more is to be imputed to intermittents, in those districts in which they are endemic.

It may be asked, whence arises the greater mortality of the other four counties, of which the rate is above the average. With regard to Middlesex, it is imputable no doubt to the various circumstances adverse to health, peculiar to the metropolis, such as the more intemperate habits of life, and perhaps still more the unfavourable influence of the air of this great city, particularly on young children. It is worthy of remark, however, that London has of late years been improving in salubrity; for it appears by the bills of mortality, that the burials invariably and considerably exceeded the christenings, till a few years before the close of the last century: whereas since that time the christenings have generally exceeded the burials. This may in part be ascribed to vaccination; but it cannot be entirely owing to this cause, for the decrease of burials took place some years before that admirable discovery. The first year on the records of the bills of mortality, in which the births exceeded the burials in this metropolis was 1790. The great diminution of mortality among young children, so as to amount now to little more than one-half of what it was as late as the middle of last century, has already been adverted to at page 122. In farther proof of the improving health of London, it is stated in this Parliamentary Report, that the annual mortality in 1700, was 1 in 25; in 1750, 1 in 21; in 1801, and the four preceding years, 1 in 35; and in 1810, 1 in 38. The increased mortality in the middle of last century, has been imputed to the great abuse of spirituous liquors, which was checked about that time by the

actions of a Society for the Improvement of Medical and Chirurgical Knowledge. London, 1812.

imposition of high duties. The other causes of superior health, seem to consist in a general improvement in the habits of life, particularly with regard to ventilation and cleanliness, a more ample supply of water, particularly since the new water companies began to supply the town, greater abundance, and better quality of food, the improved state of medicine, and the better management of children.

The high proportion of mortality in Surry is no doubt owing to its containing a portion of the metropolis, consisting of a population of 170,000, which is more than one-half of the whole county.

The high rate of mortality in Warwickshire, seems at first sight the most difficult to be accounted for, the air of this part of the kingdom being very salubrious. It is no doubt owing to the town of Birmingham being situated here, for it comprises two-fifths of the population; and the mortality, on the average of the last ten years, is 1 in 34. The mortality in this town is greater than in Manchester, Leeds, or Norwich. The operations in metals* have been alleged as the cause of this; but it is much more probably owing to the want of attention to cleanliness and ventilation, particularly with regard to the streets, which are said to be very narrow and dirty.

With regard to Lancashire, where the mortality is somewhat above the average, the number of large towns and extensive manufactures, affording a greater proportion of artisans, to rural inhabitants, than in any other county, except those in which the metropolis is situated, is certainly the cause of this, for the air is very salubrious, and the great quantity and cheapness of fuel is extremely friendly to life, health, and comfort. It is probably owing to this advantage, that the inhabitants of this county, particularly the females, have become noted for their well-formed persons and comely countenances, forming a contrast with those of Buckinghamshire, where the fuel was extremely scanty and high-priced before the late extension of the inland navigation, so that the labouring class suffered peculiar hardship from this privation, and are of a stature so inferior, that the Militia-men are, by Act of Parliament, admissible at a lower standard than in the rest of England. The report of Manchester, which is the second town in England in point of population, forms an exception to the rest of Lancashire, for the mortality there on the average of the last ten years, was 1 in 58, and in the year 1811, 1 in 74. But that of Liverpool was 1 in 34 on the average of ten years, and 1 in 30, in the year 1811. In the former we have another pleasing picture of the progressive improvement of health, for it is stated by the late Dr. Percival, that in the year 1757, the annual mortality of Manchester was 1 in 25.7, and in 1770, 1 in 28; although at the former period the population was not quite one fourth, and at the latter period, not one-half of its present amount.* This improvement of health is clearly imputable to certain regulations of police, particularly with respect to ventilation, recommended and introduced by the above-mentioned benevolent, enlightened, and active physician. Since that time much praise is due to Dr. Ferriar, who followed the footsteps of Dr. Percival.

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* See Ramazini de Morbis artificum.

The like progressive amelioration of health, is deducible from these public documents with respect to the whole kingdom, as already stated.

This statement of facts, coupled with the general result of the population returns, together with the annual increase of wholesome subsistence from the rapid extension of agriculture, may be fairly deemed a proof of the increasing happiness, power, and prosperity of this country, and cannot fail to afford the most solid satisfaction and delight, to every benevolent and patriotic mind, notwithstanding the present distressed state of land-proprietors and cultivators, which, it is to be hoped, will prove temporary.

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* See the Works of Dr. Thomas Percival, vol. ii. Warrington, 1789.

I shall conclude this Dissertation with a few remarks on the progress of population, which, except where it exceeds the limits of food and employment, as in China and Ireland, and perhaps in England at this time, as far as regards employment, may be taken as one of the fairest criterions of the health, wealth, and general prosperity of a nation.

The historical materials on this subject in the early history of England are so scanty, as to leave too much room for conjecture. I am informed by Mr. Rickman, whose superior competency to judge of such subjects must be undeniable to those, who know that it is he who has, with so much industry and sagacity, digested and commented on the three decennial censusses which have been taken of Great Britain, that, according to the best inferences which can be deduced from Doomsday Book, the population of England in the time of William the Conqueror was about one-sixth of what it was at the enumeration of 1811. By this calculation it would be 1,589,609.

The next era at which we find any *data* on which to found an approximate conclusion on this subject, is in the reign of Edward III. A.D. 1377, when a poll-tax of fourpence was imposed on all persons of both sexes above the age of fourteen.* The taxable persons were found to amount to 1,405,602. The number under this age, by some of the best constructed tables, is one-third of the whole population, which would therefore be 2,108,403, and stating one-fifth of the taxable subjects as the probable number of those who would elude the tax, would be 2,635,503.

The next historical incident which throws any light on this subject, is the general muster of fighting men, made on occasion of the threatened invasion by the Spaniards in the reign of Queen Elizabeth. This list amounted to 1,172,000, on the authority of Sir Walter Raleigh, in his Essay on

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* See this adverted to in Sir Richard Worsley's History of the Isle of Wight, page 10.

Shipping. The proportion of fighting men to a whole population is computed to be from one in four to one in five, but as the public zeal at that time in repelling the meditated aggression of the enemy would make great numbers forward to enroll themselves, we may safely take it at one in four, which will make the total of men, women, and children, somewhat more than four millions and a half at that crisis. This was an encrease of more than two millions above the age of Edward III. a space of 200 years, whereas the encrease from the Conquest to Edward III. a space of 300 years, was little more than one million. This might naturally be expected from the oppressive government of the first Norman king, and the devastating wars and pestiences under Edward III.

Mr. Rickman, on a computation founded on the return of baptisms, as stated in the abstract of parish registers, makes the population of 1700 amount to 5,475,000, that of 1750 to 6,467,000, that of 1770 to 7,428,000.

The first actual enumeration was made in 1801, suggested by the two preceding years of scarcity. This gave to England and Wales 9,168,000, and a mortality of 204,434, that is, 1 in 44.8 of the year in which it was taken.

That of 1811 gave a population of 10,488,000, and a mortality of 208,184, that is, 1 in 48.7 in the year in which it was taken. There was therefore an increase of population in these ten years of 1,227,635, and a diminution of mortality in the inverse ratio of 44.8 to 48.7. The average mortality of the twenty years computed in the two censuses was 1 in 50. It may here be remarked, that from the nature of the thing, errors of *defect* are much more likely to occur than errors of *excess*, particularly in the first enumeration, both because the methods of collecting the numbers were less perfect, from want of experience, and from a jealousy of its being intended for some purpose of taxation, or military levy. This error would be in some measure compensated by a like error in the burials.

The enumeration of 1821, has given a population of 11,977,663, being an encrease over the last of 1,827,048, a number more than equal to the whole population of England, exclusive of Wales, at the Norman Conquest, and greater than that of England, probably exclusive of Wales, three hundred years afterwards, as already stated. As the returns of 1821 have not yet (June, 1822) been finally digested, the mortality of the last *decennium* has not yet been printed, but it is expected not to exceed 1 in 57.

The present population of England, therefore, is more than seven times what it was from the eleventh to the fourteenth century, three times what it was towards the end of the sixteenth century, has more than doubled itself since the last year of the seventeenth century, and nearly doubled itself in the last seventy years.

It is a matter of the deepest moment to those who are in the habit of meditating on the fluctuations and unequal distribution of public prosperity and national happiness in this or other countries, to consider by what means the subsistence of the people of England has kept pace with their numbers; it is also singularly interesting and curious to reflect on the accelerating rapidity of this increase in the late, and still more in the present generation, and pleasing to remark, that there has been less distress from deficiency of food in this period, than in any other of equal duration in any part of our history. It is self-evident, that the supply of subsistence, from whatever sources it may have flowed, must have kept pace with the progressive population, and it appears that it has done so with a degree of abundance and regularity unknown in former ages. The main source must have been domestic production, for imported food, even when at the highest, has constituted but a small proportion of the total stock of subsistence. This encrease of production has been effected by the extension and improved skill in agriculture, as applied to the cultivation of bread-corn for the food of man, of pasture and provender for that of cattle, and the introduction of potatoes for the sustenance of both. But notwithstanding of these augmented resources, this country, which had formerly great quantities of corn to spare for exportation, encreased so rapidly in population in the middle of the last century, that exportation ceased about the year 1766, and importation became necessary for the demands of internal consumption. This was particularly conspicuous in the two consecutive years of scarcity, which terminated the last century, during which twenty millions sterling was expended on foreign corn. From the stimulus given by high prices on this occasion, agriculture was carried on with all that spirit or rage,* as it has been called, of speculation which was thought to belong only to manufactures and commerce. With so much vigor and success has this been done, that the productions of husbandry have been raised to such an enormous amount as, even under an increasing population, not only to supersede foreign importation, but to render it an indispensable matter of policy to exclude it. This was done by the corn bill of 1815. Even this has not saved the agricultural classes from that deep distress which overtook them in 1814. This, however, is not imputable entirely to the exuberant, domestic production of corn: for, ever since the year 1806, the importation from Ireland has been rapidly increasing so as materially to interfere with the English markets. The encreased consumption of potatoes since the two years of scarcity cannot fail to have had a like influence on the price of corn.

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* Though the additional land brought into cultivation by the division of commons does not comprise the whole amount of the late additional productions of agriculture, a recital of the encreased number of enclosure bills, at different periods, will be no bad index of the growing spirit and extension of agriculture. There were none before Queen Anne, in whose reign, of twelve years, there were three; in that of George I., of fourteen years, there were sixteen; in that of George II., of thirty-three years, there were one hundred and forty-four; in that of George III., of sixty years, 5058, making an annual average of eighty-four in the late reign. But that portion of it in which the greatest number of these bills passed was the first fifteen years of this century, during which they amounted to 1420, making an annual average of ninety-four, exclusive of fractions. The number of these bills has rapidly declined ever since; for, the whole number from 1816 to 1821, both included, has been only 301, that is, an annual average of fifty. Some idea may also be formed of the encrease of agricultural industry, from the superior proportion which the agricultural population bore to that employed in trades, manufactures, and handicraft, in 1811, compared to 1801. By the returns of 1801, the rural population exceeded the trades by one-sixth; but by those of 1811, by one-fourth, as any one may satisfy himself by consulting the abstract of the population at these two periods. But the classification of the first period was so inaccurate, that much dependance cannot be placed on it: so that the difference of the two classes in the two censuses was probably not so great as here stated.

It may be apprehended that the author is here again in danger of deviating into discussions foreign to his subject. But from the statement with which he is going to conclude this Dissertation, it will appear how intimately the science of Life and Health is related to Political and Economical Science. The following statement has the great merit of being grounded on principles which do not admit of possibility of error in their application or results. It is built on a comparison of two similar financial operations of life annuities, one in the year 1693, the other in the year 1789. The evidence is that of mathematical demonstration, and the facts are of unquestionable accuracy, the ages and lives being recorded in the Exchequer. They are exhibited in the following Table, the fidelity and exactness of which will not be doubted, when the reader is informed that the Author is indebted for it to Mr. Finlaison, one of the most able calculators of this age, and is part of a series of labours in which he is assiduously engaged for the general benefit of society, as well as of the state.

A Table exhibiting the law of mortality in two different periods:

Ages.	Mean duration of life, reckoning from		So that the increase of vitality is in the inverse ratio of 100 to
	1693	1789	
5	41.05	51.20	125
10	38.93	48.28	124
20	31.91	41.33	130
30	27 57	36.09	131
40	22.67	29.70	131
50	17.31	22.57	130
60	12.29	15.52	126
70	7.44	10.39	140

Whoever will cast his eye on this, will perceive with mingled surprise and satisfaction the highly improved value of life in the age in which we live. The persons, upon whom the calculation is made, are, no doubt, select lives, taken from the middle ranks of society; but as they are similar cases, the comparison must be admitted to be fair. But a like improvement in the health and duration of life in society at large, is deducible from the comparison of the *censuses*. The statement, as exhibited above, would not indeed be credible, if it did not rest on demonstrated conclusions, and not on those probabilities, conjectures, vague analogies, loose and questionable inferences with which the ordinary reasonings in political economy so much abound. Without such well-founded assurance, who could believe that human health and longevity are so superior, in the present age, to that immediately preceding it, as to afford the chance of nearly one-third more of earthly existence? And can it be doubted for a moment that all those means which add length to life, add also to its substantial happiness, respectability, and virtue. Various causes for this great change have been assigned in this, and the preceding Dissertation, but it is hardly conceivable that they could have operated with such powerful effect. And while this is consolatory to society, it is flattering and encouraging to those who have lent their best endeavours to ameliorate the condition of humanity, and who have met with their best reward in their success. The causes appear chiefly referable to the more ample supply of food, clothing, and fuel; better habitations; improved habits of cleanliness and ventilation in persons and houses; greater sobriety, and improved medical practice. Whether these causes operate with a relative degree of effect corresponding to the order in which they here stand, or any other order, must be matter of opinion; but if health and long life are to be admitted as the surest criterions and constituent elements of human happiness, it would appear that we have much reason for self-congratulation in having had our lot cast in this age and country.

DISSERTATION VI.*

I. *On the Effect of large Doses of the Carbonates of Potash in Gravel, with Remarks on their administration, particularly on the advantage of combining them with Opium, and other Narcotics; also, on the virtue of Opium in the case of Diabetes and Intermittent Fever, and as an Alexipharmick.*

II. *On the Use of pure Alkalies and Lime Water, in Disorders of the Bladder, Stomach, and Skin.*

When alkaline substances were first recommended as remedies for stone and gravel, it was thought that they were efficacious only in their pure state. This proved a bar to the free use of them, for their causticity in that state, necessarily limited the dose. But having heard my respected colleague at St. Thomas's Hospital, the late Dr. George Fordyce, remark, that in his opinion the mild alkali was equally efficacious, and having heard the late ingenious Dr. Ingenhousz mention the great benefit he had derived in his own case from what was then called the *aqua mephitica alkalina*, the name by which the solution of potash sur-charged with carbonic acid was then known; having also met with an excellent Tract on the same subject, by Dr. Falconer of Bath, I determined to make trial of it, but without abandoning the occasional use of the pure alkali.

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* The substance of this article was published in the year 1811, in the Transactions of a Society for the Improvement of Medical and Chirurgical Knowledge, vol. ii. and iii.

But this alkali, in the ordinary state of its impregnation with the acid, that is, in the proportion of seventy to eighty, and called the sub-carbonate, in which form it was at that time most commonly used, though not so exceptionable as in its pure form, is still so acrid and nauseous as greatly to restrict the dose. It occurred to me that this might be obviated by neutralizing part of the alkali, and thereby extricating a portion of the carbonic acid which has so remarkable an effect in reconciling ungrateful medicines to the palate and stomach The usual method I followed for adults was to dissolve two scruples, or even a drachm, in two or three ounces of water, to sweeten this solution with two drachms of honey, and to direct it to be taken, with half an ounce of lemon juice, or vinegar, three times a day. I preferred honey to sugar, on account of the mucilage it contains, and because I heard the late Sir John Pringle say, that he believed it to be a good remedy in nephritic disorders. I have also found this quantity of honey, in many cases, sufficiently laxative to supersede the use of medicine for that purpose, and which the opium, which I was in the habit of adding to each dose, might render necessary. The alkali, with a higher impregnation of carbonic acid, that is, in the proportion of seventy to sixty, and called the carbonate, or bicarbonate, being less acrid, and less nauseous, did not so much require the addition of the citric or acetous acid, but containing not much more than one-half of the alkaline ingredient, a larger dose was necessary. The preparation of it is effected by adding a solution of carbonate of ammonia to the sub-carbonate of potash, and the former, in consequence of its weaker affinity to the carbonic, parts with it to the latter. When it is fully charged and reduced to the form of a dry salt, it is no longer deliquescent, a circumstance which renders its administration more commodious.

It may be objected, that the virtue of a large proportion of the alkali is here destroyed by this method of administering it. Of this objection I was well aware, but was led to disregard it from the following considerations. First, About this time, a person under my care, taking this alkali neutralized with lemon juice, in the form of the common saline draught, was, from curiosity and amusement, in the habit of trying the urine by the test of paper stained with litmus, and found that, under the use of this medicine, the urine came to lose its power of reddening the paper, in the same manner as happens under a course of alkali. It would appear, therefore, that in the progress of the circulation, by virtue of some of the chemical changes arising in the processes of secretion and assimilation, this compound is decomposed, so as to allow the alkali to operate as if it had been swallowed separately. Secondly, Admitting that one third or even one half of the alkali were to be deprived of its medicinal quality, the portion which remains unneutralized is far greater than the palate or stomach could bear, in a separate state. Lastly, I found from experience, that the actual effects were as great, as could have been expected from the whole alkali, without the addition of an acid. It may farther be stated, as a recommendation of the practice of administering the alkali in combination with the carbonic and citric acids, that the morbid affections incident to a long use of the alkali alone are thereby prevented.

It was found advisable to adopt certain modifications and additions to this medicine, according to the variety of the accompanying symptoms. It happens not unfrequently, for instance, on the first attack, that the sharp angular concretions produce symptoms of acute nephritis, in which case the usual quantity of uncombined alkali should either be less, or omitted, till the inflammation shall have been subdued by bleeding, the addition of nitre, and other parts of the antiphlogistic treatment.

But the most important peculiarity in my method of administering the medicine consisted in the addition of the opium.

When there was great pain and irritation, without the suspicion of inflammation, I found this not only admissible, but highly advisable ; inasmuch, as it not only alleviated the pain, but if given for a considerable time, contributed materially to expedite and complete the cure. It is, indeed, this fact that has chiefly induced me to lay this Dissertation before the public. I could not help being much struck with it, but was the less surprised on reflecting, how analogous it is to what I had observed, with respect to the effects of opium in other cases of irritation. I will also confess, that I was farther induced to adopt this practice, from finding that a medicine sold as a secret, evidently consisting of alkali conjoined with opium, had in some cases of gravel been more effectual, than the alkali directed by myself without this addition. I have, therefore, for several years been in the habit of adding from seven to fifteen drops of vinum opii to each of the doses of the alkali, and am fully satisfied, that it not only prevents the distress arising from irritation, and facilitates the discharge of calculi, by relaxing the spasms of the ureters, but that it renders the cure more expeditious, more certain, and more permanent. In those constitutions which do not bear opium, hemlock has been found a useful substitute. I recollect hearing Dr. Black, in his Lectures on Chemistry, which I attended in the year 1770, in the University of Edinburgh, mention that hemlock was a remedy in gravel, but whether in his own experience or not, my memory does not serve me. Dr. Prout, in an ingenious and elaborate work on urinary concretions published last year (1821), says that hyosciamus is eminently useful, particularly in those cases of concretions in which lithate of ammonia prevails.

I have elsewhere remarked,* that, in ill-conditioned ulcers, in the West Indies, opium was found superior to all other internal medicines for producing a disposition to heal. Under the free use of it, such ulcers would in place of a sanious discharge produce a healthy pus, succeeded by granulations and cicatrization. Opium appears to do this by suspending irritation, and perhaps by promoting absorption. Nor is this fact more wonderful and unaccountable, than the other changes produced in animal fluids, by the contact and action of the living solid parts in the functions of assimilation and secretion,† whether in a state of health or disease, to which there is nothing analogous in the habitudes of dead matter, unless the late discoveries of the chemical powers of electricity can be reckoned such. I afterwards, on these grounds, and in consequence of a case‡ related to me by Dr. Nooth, made trial of a free use of opium in phagedenic buboes, while I was Physician to St. Thomas's Hospital. This was attended with great success; and I find in my notes one case in particular, which after being in another Hospital for six months, and dismissed as incurable, was cured at St. Thomas's by this practice. The largest quantity the patient took daily was two grains in the morning, as many in the middle of the day, and five at bed time; but I have seen it carried farther. Mercury was found to aggravate the symptoms; and I believe that the chief cause of these untoward cases is the excessive use of it, and probably the less frequent occurrence of them of late years is owing to the more moderate and judicious use of mercury.

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* Observations on the Diseases of Seamen, p. 520, 3d edition.

† This subject has since been successfully illustrated in some well instituted experiments made by Mr. Brodie, in the Croonian Lecture of 1810, and printed in the Phil. Trans. of 1811.

‡ This case is as follows. About thirty years ago, a young medical man was affected with a phagedenic bubo, and went into the country under the conviction that it would prove fatal, as he had observed, in the course of his education, that this was the usual termiation of similar cases. In order to allay his sufferings of mind and body, he determined to make a free use of opium, and raised the dose far above what in common practice was considered as advisable, or even safe, setting no limits to it but the attainment of ease. The consequence was that the ulcer began to suppurate kindly, and finally healed. Dr. Nooth, to whom this case was known, went soon after to America, as Physician to the Army there, and took pains to communicate the knowledge of this to the medical officers of the army. A physician, belonging to the Hessian troops, who then served in America, conceived from misapprehension, that opium was a remedy for the venereal disease in all its forms, and very hastily, and most reprehensibly, published a small tract to this effect. The novelty of the practice, and cofindent tone of his work, procured it a wide circulation and some credit, insomuch, that, when I returned to England

I need not remark to those, who are in the habit of reflecting on the principles of the animal œconomy, and the operation of medicines, that all the healing processes are ultimately and essentially the work of nature, that the means employed by art consist merely in enabling nature to perform these processes, or in removing such obstacles as impede her operations, and that of these obstacles one of the chief is irritation. Upon this principle, it can as readily be conceived, how the morbid action generating gravel may be encreased by the irritation of that gravel, as that a

after the war, I found that some of the most eminent practitioners had been making trial of it in virulent gonorrhœa, and chancres, either in their private or hospital practice. The fallacy was soon detected; but the remedy shared the fate of many other excellent medicines. Not having been found good *for every thing*, it was condemned as good *for nothing*, and discarded, so that the practice was neglected, or but little attended to, in those cases to which it is really adapted, for which it had been originally intended, and in which it will ever be found of benefit.

The employment of opium, in venereal ulcers, is very accurately stated in a pamphlet published by Mr. Grant, entitled 'Observations on the use of Opium, in removing Symptoms supposed to be owing to Morbid Irritability. London, 1785.

sanious discharge should be kept up and encreased by its own acrimony. It may also be remarked, that the urinary organs are more liable to nervous influence, and consent of parts, than most others, as is exemplified in the sympathy of the stomach from calculous irritation, and the great quantity of pale urine secreted in hysterical and other nervous affections. It is not so evident, however, in point of reasoning, how the cure of gravel by this practice should be more permanent. It might indeed be alleged, that a change produced by a medicine affecting the action of those solid parts, which are the seat of sensibility and irritability, is less likely to be transient, and more likely to be permanent, than one which merely produces temporary chemical changes on the fluids. But as the fact in question was ascertained by experience, without having been suggested by plausible speculations, I wish to rest it on the former. That this is the only legitimate criterion of practical reasoning, and that chemical experiments out of the body are very fallacious, may be illustrated by another fact belonging to this subject. A gentleman, subject to frequent fits of gravel, was in the habit of making experiments on the small concretions which he passed. He found that soda dissolved these, but that potash did not; nevertheless, he experienced sensible relief, and even temporary cure, from the internal use of the latter, but no benefit from the former.* As far as I can judge of the comparative powers of the two alkalis, I should greatly prefer the potash to the soda, as a remedy for the cases in question. One reason of this may perhaps be, that soda is an element of the animal fluids, as it enters largely into the composition of the bile, so that it is more likely to be arrested in the course of circulation, and diverted from the urinary organs. I may observe by the way, that the patient above-mentioned has for a series of years been subject to frequent relapses, but that I never could prevail on him to use opium, as he has, like many others, an insurmountable objection to this drug.

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* A remarkable instance of the inefficacy of soda, though given in large quantity, is related in Mr. Home's Observations on Mr. Brande's Paper on the Structure of Calculi, inserted in the Philosophical Transactions for 1808.

I hope what I have said in favour of opium will not be considered, as giving countenance to that indiscriminate use of it in various internal complaints, which has of late prevailed in medical practice, in consequence of some hypothetical doctrines that have been propagated. Let it not be forgotten, that the maxim, that *the best things are the most liable to abuse*, is peculiarly applicable to medicines. Its beneficial effects are limited to cases, in which there is spasm or irritation in some form or other, either manifest or obscure. I have found it uniformly hurtful, where there is either inflammation or simple debility, that is, debility proceeding from a natural failure of the powers of life, and it probably never proves cordial and exhilarating, but where there is some spasm visible or latent. It has a striking effect in those cases or constitutions, where chilliness, and languid circulation, are the predominant symptoms; and what is chilliness, and the sensation of cold, but a spasm of the extreme orifices of the cutaneous vessels, as is manifest from that rough constriction of the integuments vulgarly called *goose-skin?* The reader is referred for a still farther proof and illustration of this to what has been said of opium in the cure of intermittent fevers at page 105 of this volume.

It is not foreign to the present subject to observe, that opium has a remarkable power in mitigating the effects of poisons. Dr. Reynolds* found, that the danger arising from the internal use of the cerussa acetata is obviated, by conjoining it with a small quantity of opium. I have experienced the like good effect from this combination. I have employed it with the same intention, and with the like good effect, in obviating the virulent powers of arsenic; and it is fortunate, with respect to intermittent fever, that the virtues of both these concur, having been found separately, as well as jointly, powerful remedies in that disease. In illustration of this, I beg to give the outlines of a case, which occurred to me a few years ago. In the year 1800, there was a camp at Swinley, near Windsor, in which an intermittent fever appeared, and it was observed that those only were affected with it, who had served in the campaign of North Holland, in the autumn of the preceding year, affording a curious and well ascertained exemplification of the reality of latent predispositions. One of the officers, affected with a tertian intermittent, came to town to place himself under my care. Having a pain in his right side, which was suspected to have arisen from a chronic affection of the liver contracted in a tropical climate, where he had served a few years before, I was desirous of curing him without the bark. After the usual evacuations, therefore, he took opium before the fit, in the manner already described, and also every night at bed-time, by which the paroxysms were mitigated, but not prevented, at the end of the first week. I then directed ten drops of Fowler's solution* of arsenic to be given every four hours, after which he never had a rigor, but only an uneasy jactitation at the usual time of the paroxysms; and this disappeared upon raising the dose gradually to fifteen drops. This dose was continued for a few days, and the disease was entirely removed, without the least inconvenience having been felt from the remedies. As the dose of arsenic here administered was considerably above what is regarded as advisable, or even safe, I have no hesitation in ascribing this safety to the opium, particularly as I have observed the same effect in other cases.

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* Medical Transactions of the College of Physicians, vol. iii. page 99.

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* A preparation of this mineral of the same strength has been inserted in the edition of the London Pharmacopœia of 1808.

It seems worth enquiring, whether the deleterious effects of vegetable and animal, as well as the mineral, poisons, might not be prevented by opium. We know that the ancient compositions called alexipharmaca and theriaca, in which opium was the most important ingredient, derived their appellations from their real or supposed powers of counteracting poisons ; and it would be difficult to say, upon what grounds the moderns have pronounced so hardily, that the confidence of the ancients in these compositions was founded in credulity and superstition. If I had the misfortune to be bit by a mad dog, I should place much more reliance on due doses of some of the officinal opiates, taken habitually, till the predisposition might reasonably be supposed to be obliterated, than on any thing that the moderns have suggested as an antidote to this poison, being seriously of opinion, that opium affords a very likely means of counteraction, particularly if combined with arsenic, which has been proposed as a remedy in this disorder by Dr. J. Hunter.* We have seen how well these two medicines accord in the cure of agues ; and it may be remarked, that the remedies for ague partake, in their application and operation, of the nature of prophylactic means ; for they are administered, during the absence of the paroxysms, with a view to prevention, in a complaint of which the remote cause is a morbid poison.

A few other practical remarks may be made, before dismissing the consideration of this interesting article of the materia medica. One is, that I have not seen it manifest any of its peculiar properties, whether local or general, that is, any narcotic, anodyne, anti-spasmodic, or exhilarating effects, except when brought into contact with some portion of the alimentary canal.† The next is, that in those constitutions, in which it ordinarily produces nausea, head-ach, febrile heat, and other distressing sensations, it has not in general these effects, when such constitutions labour under severe spasm and irritation, which it is then equally effectual in removing, as in any other constitution. Lastly, the effect of opium in diabetes, is highly illustrative of the principle, which it has been one of the chief objects of this communication to establish, namely, that the removal of irritation produces not merely a palliative and temporary, but a radical and permanent effect. Only one case of this disease has occurred to me, since I became more fully acquainted with the powers of opium. It was in a female, who had laboured under the complaint for fourteen months, and, under the use of ten drops of vinous tincture of opium thrice a day, recovered entirely in three weeks, and she has remained well now a year. Some other remedies usually directed in this complaint were taken at the same time, but their want of success, in so many other cases, leaves little or no doubt, that the striking benefit, derived from the treatment in this case, was owing to the opium. The diet, purely animal, which I enjoined, had probably the next greatest share in the cure. I also directed oily friction all over the skin, having seen evident benefit from it in like cases.*

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* See Transactions of a Society for the Improvement of Medical and Chirurgical Knowledge, vol. i. p. 294. London, 1793.

† See an important practical observation on this subject in Trans. of Med.-Chir. Society, vol. v. p. 154. London, 1814.

In the title of this paper, I have made use of the term *gravel*, meaning to distinguish the disease so called, from the stone. The gravel properly so called, that is, the recent concretions, generally accompanied at their first formation with nephritic pains, has been found to consist of uric, otherwise called lithic acid, except in a very few cases in which it consists of† oxalate of lime; whereas most of the large concretions, which have been forming for a length of time in the bladder, are found to consist, besides, of a a variety of other ingredients; and some of them contain no oxalate of lime. The discoveries on this subject do great honour to the science of this age, and are of great utility in guiding our opinions and practice, in the treatment of the complaints under consideration. The concretions of uric acid most frequently form the nucleus of stones; and it has been computed, that a fourth part of stones, found in the bladder, consist of uric acid, though Mr. Brande thinks this computation too high.* The great majority of stones are found, besides this acid, to contain ammonia, magnesia, silica, lime, the phosphoric and oxalic acids, in various combinations and proportions. A few have been found without any uric acid. In consequence of these laborious and successful researches, we are enabled to understand, why alkaline bodies are not in all cases equally effectual in curing or relieving calculous complaints. This had so far disparaged their character, as to produce a general diffidence of their efficacy in any case whatever. It is, therefore, highly important to mankind, that the extent of this efficacy should be ascertained, in order that practitioners and patients may neither be too sanguine, nor too despondent, with regard to the benefit to be expected from them. And I must here again remark, that, whatever deference may be due to the lights thrown upon this subject by chemical science, the effects of remedies on the living body are not to be decided exclusively on this principle. Notwithstanding its being found, that the greater part of the substances, of which stones consist, are incapable of being acted upon by the fixed alkalis, it is conceivable that alkaline remedies may be useful in all cases, if we are to admit what has been plausibly alleged by some theorists that, they act rather by correcting the powers of digestion, than by their chemical property of neutralising morbid acidity. The opinion of there being any remedy that can properly be called a solvent, is now laid aside by all correct reasoners and practitioners. But though there may be no proof of their having dissolved a stone, properly so called, yet they frequently do what is equivalent; for by preventing fresh concretions, which from their crystalline form are extremely sharp, the stone becomes so smooth, as to lead to an opinion that it has actually been dissolved. This was particularly remarkable in the case of Lord Walpole, treated and described by Dr. Whytt about the time when this medicine was first introduced into regular practice. This patient was relieved from the sufferings of the stone for several years before he died, which was at the age of eighty, although the stone was found in the bladder after death.*

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* See an article in the 4th volume of the Transactions of the College of Physicians on the use of opium in Diabetes, by Dr. Pelham Warren.

† See Mr. Brande's Letters to Mr. Home on the Structure of Calculi, in the Philosophical Transactions of 1808.

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* See Journal of the Royal Institution, vol. vi.

It is certain, however, that the neutralising property of alkaline substances does reach the urinary secretion; for, by the internal use of them the urine loses its quality of reddening the blue tests. Nor, can it be doubted that alkalies, magnesia and lime have the effect of aggravating cases in which the concretions consist of the triple phosphates, and ought here to be avoided. The other positive improvements in practice suggested by the intimate knowledge of the ingredients of these concretions have been the successful use of magnesia in cases of the uric acid, and the use of acids, vegetable or mineral, in those cases in which the prevailing elements are alkaline, generally distinguished by the excretion of white sand as the others are by that of red sand. A scruple of carbonate of magnesia, twice a day, has been found to answer as well as the alkalis; and nitric, or muriatic acid, from five to fifteen minims thrice a day, largely diluted, have proved eminently useful in the appropriated cases. I shall conclude with remarking, that all the substances found in the composition of stone, except the uric acid, of which there is a certain proportion in the most healthy urine, seem to be the creatures of morbid irritation.* In almost every instance, the concretions of uric acid form the nucleus of stones, which would not be the case, if the other substances were produced independently of irritation from the stone itself. The specific effect of this irritation, as the stone advances in size, is to produce, by exciting morbid secretion, the various other compounds which have been enumerated :† and there seems to be particular stages of its growth, at which it produces one compound rather than another, as appears by the strata of urinary stones. The several strata may be considered as expressions of this fluctuating action, so as to be registers, as it were, of the duration and succession of these actions, in producing the several species of matter composing stratified stones. The stratum of oxalate of lime, which gives a mulberry appearance to the stone, is seldom formed till the stone has attained a considerable size, being rarely found in the central parts of these concretions..* This being the case, whatever tends to obviate irritation, will likewise tend to prevent the generation of calculous matter of every description except uric acid. Both the medicines I have mentioned possess the property of diminishing irritation; for not only has opium this effect, but also the alkali, as I shall endeavour to prove in the next part of this Dissertation; and the aqua mephitica alkalina has been found to remove† bloody urine and strangury, though not proceeding from gravel or stone.

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* See Dr. Whytt's Works; also two remarkable cases of cures by lime water and soap, by the same author, in the Medical Essays of Edinburgh, vol. vi. page 159 and 278.

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* To assert this kind of creative power of secretion seems a bold position. It can, nevertheless, be maintained with considerable plausibility, and even probability, if not with certainty. The natural history of calcareous earth lends great support to this hypothesis; for, it is not conceivable that the vast masses of shell which compose whole mountains of chalk and other masses of carbonate of lime so immense as to constitute a sensible part of the globe of the earth, could have been derived from such a quantity of it as could enter into the food of the animals of which they are the *exuviæ*. And if the organs of living creatures can create such enormous mounds, what is to hinder them to create such minute portions of lime, silica, and magnesia as enter into the morbid concretions in question? Mr. Hatchett, so justly celebrated for his experimental precision in chemical analysis, in conversation with me, adduced the following fact in support of the same hypothesis. A chick, just extricated from the shell, possesses bones which consist of phosphate of lime, though these elements could have no access to it during its growth. And does not a familiar and undeniable fact in the history of land animals lend some countenance to this opinion, however incredible at first sight? for, is any thing better known than that the soft parts of animals, quadrupeds for instance, which are nourished by substances so different as animal and vegetable matter, do nevertheless consist of matter of the same chemical composition?

† I am glad to find my ideas respecting the operation of opium, and the action of irritation in generating and modifying urinary concretions confirmed by so respectable an authority as that of Dr. Prout, in his Enquiry into the Nature and Treatment of Gravel. Lond. 1821.

II. It was remarked in the first part of this Dissertation that the alkaline remedies, in their mild forms, that is, combined with carbonic acid, had in some measure superseded their use in their pure state. But I have from experience seen good reason why the latter ought not to be entirely abandoned; for I have found it in several instances more efficacious than the other. In looking over my notes, I find a case which occurred to me ten years ago, where the carbonated potash had been fairly tried without any good effect; but the complaint readily yielded to the alkali in its pure state. The main objections to it are its acrimony and nauseousness. These should be covered by mucilaginous and sweet substances, some mild aromatics, and large dilution.* Another alleged objection to it is, that its long continued use brings on a disordered state of bowels of a peculiar nature. Magnesia, though the mildest of all such remedies, is not without a similar objection; for, the protracted use of it has been known to produce hard concretions causing considerable disturbance in the intestines. I have known one case of this, and more are mentioned in the Journal of the Royal Institution.† I have sometimes advantageously combined the pure alkalis in half the above stated dose with two or three ounces of lime water, blunting the acrimony with a spoonful or two of milk. By the formula, it will be seen that it has been my practice to combine opium with the pure, as well as with the carbonated alkali. And I beg to repeat, that secretion, whether healthy or morbid, being an action of life, is more likely, considered *a priori*, to be affected by causes acting on sensibility and irritability than by agents merely chemical, and that this is confirmed by experience.

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* It makes no difference, either in the reasoning here employed, or in the practice proposed, whether the constituents of stone are derived from the urine, as secreted in the kidneys, or, as is alleged by Dr. Austin, from the surface of the bladder. See a Treatise on the Origin and Component Parts of the Stone in the Urine of the Bladder. London, 1791.

† See Dr. Falconer's Cases before quoted.

In the year 1796, I was induced to lay before a private society‡ which met monthly for conversation and the collection of papers on subjects of medicine and surgery for publication, some observations on the effects of pure alkalies and lime-water in several disorders, not including stone and gravel complaints, in which their virtues were chiefly known. The cases alluded to were those of urinary irritation not depending on calculous concretion, indigestion, and certain cutaneous affections. My attention was drawn to the first of these by the following incident:

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* The following may be taken as a specimen of my formulas; Recipe aquæ puræ vel cujusvis aquæ distillatæ aromaticæ, mucilaginis gumm. acaciæ āā f. ℥ij. Mellis despumatæ ℥iss. liquoris potassæ f. ʒiii. Vini opii m. xl ad ʒi. M. Sumantur cochlearia duo magna e poculo decocti hordei ter in die. Interdum addantur singulis dosibus spiritus juniperi compositi f. ʒij. vel potassæ nitratæ ℈i.

† Vol. i. page 297.

‡ This is the same Society alluded to in the first part of this Dissertation. It consisted of the justly celebrated John Hunter, its founder. Dr. George Fordyce, Dr. John Hunter, Dr. David Pitcairn, Dr. Baillie, Dr. Andrew Marshal, Sir Everard Home, Dr. Patrick Russell, and myself. Three volumes were published by this Society under the title of Transactions of a Society for the Improvement of Medical and Chirurgical Knowledge, between the years 1793 and 1812. The founder and most of the above mentioned members contributed to the collection.

A captain of a line of battle ship, in returning to England from the West Indies, after the peace of 1783, was seized with a fever, for which, among other remedies, a blister was applied. The usual means of preventing strangury having been neglected, he was much distressed by that symptom, and he continued for two years afterwards to be greatly troubled with a frequent desire to make water, which he passed with some degree of difficulty and uneasiness. He tried a variety of remedies to no purpose, so that being in a great measure prevented from going into company, and his life being extremely uncomfortable, he retired into a remote part of the country. There he consulted a practitioner who advised him to use the *aqua kali puri*, taking his complaint most probably for the gravel. Immediately upon the use of this he began to recover, and very soon got free of his complaint.

After his return to town he related this to me, and profiting by the hint, I have several times since employed the same remedy with like success in cases of a similar kind. The cases I mean are those in which there is no suspicion of stone or gravel (the only cases in which these medicines have commonly been thought useful) but where the complaint proceeded from a preternatural tenderness or irritability of the urinary passages and bladder.

I at first considered this as an empirical matter of fact, or perhaps a mere casual coincidence, no mode of accounting for it having then occurred to me. The late experiments in chemistry, however, seem to throw light on the *rationale* of this practice; for it is found that urine, in its most healthy and natural state, contains a certain portion of that peculiar acid,* which, when superabundant, concretes into gravel or stone. Even when the body is in a morbid state, it is not often found that the urine puts on an alkaline character. It seems probable, therefore, that the irritating property of the urine in this disease depends upon the acid, and that the alkali acts by neutralizing it. That the acid of the urine is, by the use of the alkali, either neutralized or prevented from being formed, is a matter of demonstration, for under the use of it the urine loses its power of reddening the blue vegetable tests, as already remarked.

May not the superior efficacy of the pure alkali over other absorbent substances depend upon a chemical fact discovered by Scheele, that the acid of the urine has a weaker affinity with alkalies, than even the carbonic acid; and may not the same be true of the gastric acid? For an alkali or an earth already combined with an acid, cannot act as an absorbent on any other acid with which it has a weaker affinity. The property of the urine by which it stimulates the surface of the urinary passages, cannot be reckoned morbid, any more than the acidity upon which it depends; for a certain degree of specific stimulus is necessary to every species of animal fluid, in order to excite the contractions of their containing cavities and vessels, either for the purpose of expulsion or propulsion, in which their respective functions consist. There are other contents in the urine, such as common salt, the phosphoric and ammoniacal salts, which have more sensible acrimony than this acid; but it does not follow that they have more effect in stimulating the bladder, for the peculiar power of fluids in stimulating their containing vessels and cavities does not depend on their simple acrimony. The natural state of the urine therefore being given, the morbid effect will depend on the preternatural sensibility of the cavity or passage with which the urine comes in contact.

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* This acid was first observed and proved to exist in the urine, by Scheele, in Sweden, about the year 1776; and its nature has been farther illustrated since by Cadet, in France, and Mr. Murray Forbes, in England. But the greatest stride made by any chemical philosopher in the analysis and classification of the several urinary concretions was by Dr. Wollaston. The account of his discoveries is Published in the Philosophical Transactions for 1797, and led the way to farther researches which have placed this branch of animal chemistry on the most clear and satisfactory foundation, from being one of the most dark and imperfect. The first complete exposition of this subject was in Dr. Marcet's Treatise on Urinary Concretions. Lond. 1817.

These facts, and the explanation given of them, throw light also on a circumstance already adverted to, and known to most practitioners, that the alkaline medicines given as lithontriptics mitigate and even remove the symptoms of the complaint, though the stone remains undiminished in the bladder. This arises, I apprehend, not only from the smoothness of the stone, in consequence of no new accretion being formed, but from the effect of the medicines in diminishing the acrimony of the urine.

What has been said of the pure alkali will also apply to lime-water; for though I have not equal experience of this last, yet I have seen manifest advantage from it, and have sometimes employed it interchangeably, sometimes in conjunction with the alkalies.

One of the most remarkable instances of relief from these medicines was in the case of a patient, who, in consequence of strictures of the urethra, came to be affected with an opening in that passage *in perinæo*, and had at times laboured under dangerous suppressions of urine. He was also of what is called a scorbutic, that is impetiginous habit, and had for many years had symptoms of gravel. In this state I directed a course of lime-water and caustic alkali, as the pure alkali was then generally called, under which he has for several months been free from suppression of urine, the whole of it passes the natural way, in so much that the lateral opening seems to be healed, and the strictures having been in some measure removed by bougies, which he had used more or less since the beginning of this complaint, his life has been tolerably comfortable.

The good effects of the medicines in this case were most probably owing to the destruction of acid acrimony, of which there were strong indications in the habit of this patient, for he was affected with a most intense acidity of stomach, which was cured by these remedies, and a course of diet, consisting exclusively of animal food, sea biscuit, and rice, with brandy and water for drink, a treatment from which I have found the utmost benefit in similar cases, but generally with the soda instead of the potash.

In such cases it is most prudent to begin with small doses, for in full doses I have known this medicine brought into discredit, and laid aside at the first trial, in consequence of the irritation it caused by increasing the quantity of urine, an effect which it sometimes has. The dose is from fifteen to thirty drops, thrice a day. The benefit arising from these medicines usually appears in a few days, but they must be continued from six weeks to three months to have a permanent effect. The substitution of the carbonated alkali for mitigating these irritations, is as advisable as in the case of gravel. The experience of Dr. Falconer on this point has been already mentioned at page 196.

2. The next complaints I have to mention, in which I have observed these remedies to be useful, are certain cases of indigestion, especially those in which acidity is the prevailing symptom. In these I have had the most unequivocal proofs of the good effects of Lime Water and pure Alkalies, the former being given in doses from three to four ounces, twice or thrice a day, and the latter from twenty to thirty drops, as often, diluted in a watery vehicle. I have observed a manifest superiority of the pure mineral alkali or natron, now called soda, over the pure vegetable alkali, or kali, now called potassa, in stomach complaints, and I should think the former deserves a place in our dispensatories. This course of medicine should be accompanied with an appropriate diet, as stated above.

In reasoning upon these facts, the most obvious idea that presents itself is, that these medicines act by destroying acidity. But on account of their acrimony, the quantity in which they can be taken is so small, that this absorbing power, with regard to the general contents of the stomach, is too inconsiderable to account for the effect; and if it depended upon this alone, the mild alkalies, magnesia, and the common calcareous earth, ought to have much greater power, as they can be taken in much greater quantities. This however is not the case, except in some of the complaints of children depending on acidity, which are cured by large doses of the earthy absorbents. But in the chronic diseases of the stomach in adults, these have merely a palliative effect, while the pure alkalies and lime water have an evident effect in correcting the function itself of the stomach, and thereby producing permanent relief.

But though these medicines cannot be administered in sufficient quantity to have a sensible effect on the contents of the stomach, consisting of the *ingesta* rendered acid by vitiated digestion, yet it is conceivable, and even highly probable, that they may act on what may be called the *gastric acid*, which may be secreted in so concentrated a state, or in such quantity, as to constitute disease. I have satisfied myself that there is such an acid, by applying the usual tests to the inner surface of the stomach of animals. This property in ruminating animals is confined to the digesting stomach, and is found not only in the stomachs of those recently killed, but of those which have been preserved in pickle, as in that of a calf which has been cured for rennet. There can be no doubt but the power which this possesses of coagulating milk is part of the digestive faculty inherent in it: and though this faculty in its full extent has been abundantly proved by Dr. Fordyce* to depend upon the living power, yet it is evident, from the stomach of the calf retaining the coagulating property so long, that this is an effect purely chemical, that is, consisting in the mutual action of dead matter upon dead matter. It would be losing time to pursue these speculations any farther, for the practical conclusions do not at all depend upon them, but upon observation and experience.

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* See Treatise on the Digestion of Food. London, 1791.

The only other remark I know of, relating to this part of the subject, is, that lime water is sometimes eminently useful in chronic dysenteries of the lienteric kind, and it probably acts by correcting the functions of the stomach. This is no new remark of mine, but I can testify the truth of it from my own experience.

3. There is another class of disorders in which the good effects of lime water and pure alkalies have not hitherto, in so far as I know, been sufficiently attended to. These are certain cutaneous complaints, particularly those affecting the face, and commonly called *gutta rosea*. I do not know whether it is conformable to the observation of others, but I have found cutaneous complaints so frequently connected with calculous complaints, that I cannot help inferring that the same constitutions are liable to both. This is more particularly the case with those impetiginous affections which depend on an hereditary constitution, and incident to what is called a scorbutic habit.

Cutaneous complaints are still oftener connected with complaints of the stomach. This is most commonly observable in eruptions of the face, which very usually co-exist or alternate with indigestion. It is also very common to observe more general defædations of the skin connected with hypochondriasis and hæmorrhoids, both of which may generally be considered as impetiginous affections of the intestines. But in so far as I have observed, it is in those cases more particularly which affect the face, that the Lime Water and Alkalies are beneficial; and it seems probable, that these medicines act upon one and the same principle in the good effect they produce, both in the external and internal complaints.

I have also, however, seen some remarkable cures of herpetic complaints of the legs, by large doses of lime water, not less than three pints a day. I was induced to try it in such cases, by a very striking one related in the first volume of the London Medical Observations and Enquiries, published in the year 1757.

All the excretions of the skin which I have tried by the usual tests have shewn an acid character. Whether this has any connection with the operation of the medicines I will not pretend to determine; but in some cases of eruptions I have employed the lime water as a wash with manifest good effects, so as to have effected a cure after mercurial and sulphureous applications had failed.

There are certain species of boils not included in the description of cutaneous disorders which I have here in view, but in which I have heard the late celebrated Mr. Hunter say, that he had observed the use of pure vegetable alkali to be followed with relief in such a number of cases, as to render its efficacy undeniable; and he first discovered this by observing boils to be cured in a case, in which this alkali was given for a calculous complaint.

The only other disease, so far as I know, in which the medicines in question have been supposed to be beneficial, is the gout, and next to calculous complaints their virtues in this, I believe, have been most generally allowed. But as it was my intention to point out only such effects as have been less commonly attended to, I shall not enlarge upon this, and shall only remark, that in some cases they seemed to protract the intervals of this disease, while in others my expectations were entirely disappointed. There is a very impressive account of the cure of gout by the daily dose of a quart of lime water, in the third volume of the Physical and Literary Essays of Edinburgh. The strong tendency to acidity in the stomach in the gouty diathesis renders absorbents highly useful, though they may not effect a cure.

DISSERTATION VII.

On Infection.

The subject of infection or contagion,* is one of the most difficult of investigation that can be found in nature; and also one of the most important, seeing the methods to be put in practice for preventing and extirpating a large class of diseases, particularly calamitous epidemics, depend on a correct knowledge of its nature. Considered in its origin, its course, and its final purpose, no department of nature is so inscrutable, intricate, and obscure, forming a contrast with that constancy and simplicity observable in other branches of natural knowledge. How and why a secretion or exhalation proceeding from the whole or part of a diseased body, should excite the like action in the whole or the corresponding parts of another living body, seem to be problems beyond the reach of the human mind to resolve. With regard to its production, it seems to bear some analogy to the healthy functions of digestion and secretion, whereby peculiar assimilations are effected. With regard to its final cause, it would be still more presumptuous to pronounce. As infections are generated and propagated by offences against bodily and mental purity, may not the resulting diseases be considered as so many sanctions instituted by Providence, for the chastisement of human depravity. I am more inclined to view the matter in this light, than to think, with an eminent author, that they have been ordained as the means of keeping down population to subsistence,

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* I use these two words as entirely synonymous, with a preference to the former. The other from its grammatical derivation, implying contact, is less comprehensive.

Let not these obstacles and difficulties drive us to despair; let them only serve as motives to patience and diligence, and let them be viewed as the foundation of that caution, candor, and modesty, so becoming the medical character, and as the sure antidote of that arrogance and pertinacity of opinion, which are so unsuitable to the dignity of a liberal profession, and a cultivated mind. That these sentiments stood foremost in the mind of Hippocrates, as a primary principle in the study of medicine, is evinced in the first sentence of his first aphorism,* a sentence the most compendious, comprehensive, profound and instructive that perhaps was ever penned: and as no time can render it obsolete, so no frequency of quotation can render it stale, trite, or impertinent. The *experientia fallax*, and *judicium difficile*, are particularly applicable to all medical subjects. Another great name in physick, Baron Haller, seems to have had the like sentiments uppermost in his mind, for in his most elementary work, entitled the Outlines of Physiology, he evinces, *in ipso limine*, in the very title page, how deeply his mind was impressed with them, by choosing for a vignette, the Mariner's Compass, with the motto *fidem non derogat error*. The application of this to the study of medicine is pertinent and ingenious, and at the same time, encouraging, for amidst all the seductions of error with which the pursuit of knowledge, in the science of life and health, is beset, we are exhorted by this not to be disheartened, nor fall into sceptical indolence and despair, because we have no short and unerring road to truth ; just as if a navigator, in pursuing his course through the trackless ocean, were to undervalue and throw aside the mariner's compass, because of the deviations of the magnetick needle.

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* ὁ βίος βραχύς. ἡ δε τεχνη μακρη. ὁ δε καιρὸς ὀξυς. ἡ δε πειρα σφαλερή. ἡ δε κρίσις χαλεπή. Vita brevis, ars longa, occasio præceps, experientia fallax, judicium difficile.

Infection may be defined to be a matter generated by disease, and which communicates the same disease to another animal. Many of the mistakes regarding this subject have arisen from want of a definite idea of what constituted infection. And it is here essential to remark, that the several species of it are so various and anomalous in their laws, that we ought to be constantly on our guard not to be misled by analogies. Some, for instance, have been unwilling to give this name to any species of it, but what follows the laws of the small pox, by communicating disease at all times in all places and circumstances. And as nothing can be assumed on such a subject, but pure and strict matters of fact, all systematick simplifications must be avoided, no method being applicable but a historical analysis and delineation of the leading laws and characters of each species. A nosological arrangement will not therefore apply, for this is founded on some one principle of distinction. This Proteus cannot be bound with one cord. I shall therefore only attempt an enumeration of those points of difference, which characterise the subdivisions of this very anomalous part of nature, with a view to the establishment of rules for the preservation and extinction of infectious disorders, and to assist in deciding some important and much agitated questions, regarding the actual existence or non-existence of it in certain epidemic diseases.

The distinctive characters of infection above alluded to are:

1. As it belongs to diseases febrile, or non-febrile. Of the first class, small pox, measles, and plague may be quoted as examples: to the other belong syphilis and the itch. And here we have a proof of the anomalous nature of this subject, upon which I have insisted so much, for it would be impossible to arrange all infections whatever

under these two heads, on account of the varieties and irregularities subsisting among them. The hydrophobia, for instance, though it consists of a process of acute symptoms, they are of such a peculiar nature, as not to be referable to fever.

2. As it is volatile or fixed. The first is communicable through the air, the other only by contact. To the first belong febrile infection in general, also small pox, and all the other specific contagions, except cow-pox: to the other belong hydrophobia, the vaccine virus, syphilis, and itch. This distinction has also its ambiguities, for there is a difference of opinion whether the plague should be classed with the one or the other. I think it likely that such difference of opinion would never have arisen, had the infection of this epidemic been as diffusable in the air as the virus of small pox. But on the other hand, had it been as fixed as that of cow-pox or hydrophobia, it is not easily conceivable how it could spread epidemically. The probability therefore is, that the sphere of its diffusion is less than that of other febrile infections. When the extreme subtlety * of dust is considered, it seems highly probable that the infection may be communicated by the dried particles of it, being set afloat in the air and inhaled with the breath. This would give it a more confined diffusion than if it were in a gaseous form. Does not this account for the dead body not communicating the infection of plague, and also for the safety which they believe, in the Levant, is afforded by plunging the infected and suspected articles into cold water?

3. As it affects only once in life, or is capable of exciting the same disease repeatedly in the same individual. To the former belong the small-pox and other specific contagions, and constitutes that attribute which has given them this title. The plague, typhous fever, and syphilis may

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* See an article in the 8th volume of the Journal of Science, by G. W. Jordan, Esq. on the Floatage of small Bodies in the Air.

serve as examples of the other. This power of inducing future unsusceptibility, is extremely dark and inscrutable; but it is worth remarking that they are all of the febrile class, and that this is in favor of that doctrine which holds fever to be a sanative process. It is indeed evident, that if the living body were not brought into this unsusceptible state by some process or other, the action of the morbid *virus*, would in all cases prove fatal, for as it multiplies itself indefinitely during the febrile process, there could be no limit to this but the extinction of life, unless the living organs were to become insensible to it. But this is so far from being the case, that recovery begins to take place while the augmentation of the poison is going on, and would then act with greater and greater intensity, unless a state of insensibility were to take place. In pushing our researches farther on this subject, we have here another example of the endless and unaccountable varieties in every thing that regards this subject, for to some individuals the variolous infection produces a disease so malignant, that nothing can stay its fatality, while in others the disturbance is so slight as not to deserve the name of a disease, so that there is every intermediate shade of severity and mildness, of danger and safety in the cases of the individuals whom it affects. And another fact equally anomalous and unaccountable, is that it is established beyond all doubt, that the small-pox and other diseases supposed to attack only once in life, do nevertheless in rare instances occur a second time in the same subject. It is farther remarkable, that almost all the well authenticated cases of second small-pox, have been of those persons, who in the first instance had undergone it in its most severe and dangerous form. This seems at first sight paradoxical, but on further reflection it will appear that it is what might naturally be expected; for the mildness of the disease is a proof that the constitution readily takes on the unsusceptible character, whereas the violence of it is an indication of a reluctance and strong resistance in taking it on, so that in those cases where this severe combat barely stops short of the extinction of life, some share of susceptibility is most likely to be retained. The first well attested case I recollect, (unless we except that of Lewis the XVth of France, the year before), was that of 1775, which is put on record in the fourth volume of the Memoirs of the Medical Society. This proved fatal, and the first attack was of the most severe description. Innumerable other cases of the like kind, and equally authentic, have since been published. But of all the anomalies regarding the small-pox, let us most admire that anomaly which has so justly astonished the world by its inestimable importance, namely, the susceptibility of it being annihilated by the introduction of a *virus* different from its own. And to this there are likewise exceptions, as might naturally be expected in every thing that regards infection. It would have been singular indeed, and out of all the rules of probability if this infection, (itself an anomaly) had not like other contagions had its exceptions. It has also been found that there are some rare constitutions susceptible of measles a second time, a fact first, I believe, promulgated by Dr. Baillie.* One attack of scarlet fever generally secures from a future one; but I know a case of a young lady who had it distinctly three times.

The enumeration of anomalous circumstances in the specific infections is not yet exhausted, for it is clearly ascertained that there are constitutions entirely unsusceptible of small-pox, whether casual or inoculated, so that there is a series of constitutions of every possible gradation from the unsusceptible, through all the stages of mildness and severity, to those in which it is irremediably fatal.

It may farther be observed, that there seems to be some degree of loss of susceptibility in all febrile diseases, immediately after recovery. The very act of recovrey seems to imply this. Dr. Russell, though he observed that one attack of the plague was no security against another, yet he remarks that those who escaped, were generally safe during the existing epidemic season, and the like has been alleged of typhous fever, so that the result of the febrile process in all cases, is to place the system in a defensive posture, so as to resist more or less, not only the continuance of the morbid action, but to prevent its immediate renewal.

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* See Transactions of the Society for the improvement of Medical and Chirurgical Knowledge, Vol. iii. London, 1812.

4. As it is perpetual, constant, and unlimited, in distinction from that which is occasional, transient, and unlimited.—By perpetual, I mean those which prevail unceasingly, such as the small pox, measles, and other specific contagions, as distinguished from those which have become extinct, such as the leprosy and sweating sickness; or which prevail for a time, and vanish, such as the influenza. Strictly speaking, there is perhaps no contagion which has existed since the creation of the human species; for, there is every reason to believe from authentic history that there was a time in which small pox did not exist;* but having been generated and propagated, its nature is such that there could be no prospect of its extinction had not vaccination been discovered. It is not an irrational conjecture that all the specific contagions have taken their origin from animals. We know for certain of one infection that has had this origin, namely, the vaccine, and its affinity with small pox is in favour of this conjecture. It is worth enquiring, as a matter of curiosity at least, whether small pox can be traced to some graminivorous animal, such as the camel. But though the specific contagions may not have been chronologically perpetual, they are geographically universal, for no climate nor season offers any bar to their diffusion in any quarter of the globe; in which respect they essentially differ from the plague and yellow fever. The former has

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* See the History of the Small Pox, by James Moore, Esq. Lond. 1815.

never been known between the tropicks nor polar circles, confining itself to a range of atmospheric heat not much below 60°, and not so high as 80°: nor has it ever appeared epidemically in our part of Europe but at one season of the year, that is, from the end of June to the beginning of November, nor has it ever been known in any part of the New World. The yellow fever has also its geographical and thermometrical limitation, but different from the plague; for, it has never arisen but in tropical climates, and never has prevailed but in those climates and in those seasons of the temperate climates, in which the heat is as high as that of the torrid zone.

There is still another large class of infectious diseases which are not kept alive for ever like the specific contagions, but arising from a certain casual concurrence of circumstances and then dying away, (though not finally, like the leprosy and sweating sickness, and the plague of Athens,*) repeatedly revive on a renewal of the like co incidences, to which the ordinary events of human life are occasionally exposed. To these belong typhous fevers, dysentery, hospital ulcers, and ophthalmia It is impossible that any one versant in civil, military, and medical history, can be ignorant of these facts. The example of the typhous fever arising from persons not themselves labouring under fever, but under circumstances of long, accumulated, and stagnant human effluvia is put beyond doubt in the well attested accounts of the occurrences at the assizes of Oxford, 1577, at Exeter, 1586, also at Taunton;† and of those of the Old Bailey in 1736, 1750, besides many others in prisons, hospitals, and ships of war.

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* The characters of the plague of Athens are quite different from those of the modern distemper which goes by that name, and this would probably long before now have also become extinct, had it not been for the doctrine of fatalism and the squalid manner of life of the Turks.

† See Stowe's Chronicle, Short's Comparative History, and the Gentleman's Magazine for 1750.

5th. Another line of distinction might be taken from diseases which are not infectious in their first stages, but become so in their progress. The typhous fever, including the yellow fever, may be adduced as an example of this; for when it arises from constitutional tendency, from scanty and bad nourishment, from fatigue or cold, it does not become infectious till towards its termination, and not then, if cleanliness and purity of air are attended to. The same may be said of erysipelas and ulcers.

6. Some infections are limited by age. The scarlet fever very rarely affects adults. The great majority are under puberty, some between twenty and thirty; a few between thirty and forty. Only one case above forty, has occurred to my own observation.

7. There arise from time to time certain disorders in small vicinages, not reducible to any rule. They originate from some obscure and ill defined concourse of circumstances manifested only by their effects. There are various examples of them in the Edinburgh Medical Essays, the London Medical Observations, and other collections. One of the most remarkable is that recorded in the Transactions of Medico-chirurgical Society vol. ii. They are generally of the febrile character with local affections, or eruptive symptoms. But there is one in the third vol. of the Edinburgh Physical and Literary Essays, and another in the first vol. of the London Observations, which are of a chronic nature, also the Pellagra of Lombardy described by Dr. Holland.*

8. Infections may be distinguished as they are communicable from one individual to another of the same species, or from one species to another. The only examples of the second hitherto ascertained, are the hydrophobia and cow-pox.

Lastly. They may be distinguished as they are capable of being caught by a sound surface, or only by a raw surface. Of the first kind are all the specific contagions except the cow-pox. To the other belong the virus of cow-pox, malignant ulcer, and hydrophobia. In this respect they resemble the poison of venomous animals, such as snakes, which does not take effect except on a broken surface, external or internal.

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* See Transactions of the Med. Chirur. Society, Vol. viii.

From all that has been said, it seems deducible that there is not a secretion nor exhalation of the human body which may not be so vitiated as to produce diseases communicable to others by contact or respiration, under various fortuitous circumstances of concentration and stagnation, application and action; so that there may be new maladies awaiting our species, which are still to develope themselves under the endless combination of the incidents of human life, through endless ages to come.

The most common situations in which local and transient epidemics arise, are jails, hospitals, ships, and the habitations of the poor. But of all these, it is ships that afford the most fertile field for them, from the great variety and peculiarity of circumstances in which they are placed, not only from men being crowded together in close places especially in stormy weather, when the hatches and other inlets of air are shut, but from the sudden changes of temperature in passing from one climate to another, the peculiar nature of their food and drink, the exposure and fatigue to which they are unavoidably exposed, and the difficulty of maintaining cleanliness. The scurvy is one of the most prominent of the diseases arising out of these circumstances, but I do not here allude to this complaint, which is not contagious, and is too well known to require notice. What I have in view is, the histories of various disorders which have incidentally arisen in ships of war, and related officially in the Surgeons' Journals, while I was physician to the fleet in the West Indies, and a Member of the Medical Board of the Navy, in London, from the year 1795 to 1802. I shall here transcribe them as I find them in my notes, and as they have already appeared nearly in the same form in the third vol. of the Transactions of a Society for the Improvement of Medical and Chirurgical Knowledge.

1. I observed in some returns made to me by the Navy

Surgeons in the West Indies, while I was Physician to the Fleet on that station, that the spreading of ulcers in certain ships could not otherwise be accounted for, than on the supposition of contagion; and this was put beyond all doubt by facts, which I met with in the journals of ships of war, while I was Commissioner of Sick and Wounded Seamen. As these have been already published in the different editions of a * Work of mine, on the Diseases of Seamen, I need not here enter into any details.

2. Boils sometimes spread in ships, in the manner of an infectious disorder. Instances of this occurred in the Cerberus, Culloden, Penguin, and Snake. The surgeons who report these cases do not assign any cause except one of them, who ascribes it to the eating of fried bacon, and another to the drinking of sea water.

3. Ophthalmia arose, and became general in two ships, before there could be any possibility of its importation from Egypt. One of the ships was the Overyssel, a guardship in the Downs, in which this occurrence happened in the spring of the year 1798. The other was the Achille, belonging to the Channel Fleet, in the spring of the year 1800. Both of these occurred before the invasion of Egypt.

4. In May 1796, a thrush affected the whole crew of the Lion, a fifty gun ship. It appeared chiefly on the roof of the mouth, and produced so much tenderness, as to render chewing very painful. It was not attended with fever, or any other complaint. Fifty of them were treated with purging salts, and cream of tartar, twice or thrice a day, and the complaint went off in a week or ten days.†

5. I find it mentioned in the Surgeons' Journals, that the mumps *(Cynanche Parotidea)* prevailed epidemically, in ten different ships.

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* This will be found fully proved and illustrated in the 3d edition of that Work, p. 503.

† There is an account of a thrush spreading from a single case to a whole parish, in the Physical and Literary Essays of Edinburgh, Vol. III. p. 65.

6. The surgeon of the Blond frigate, reported, that, when that ship arrived in the Mediterranean, swelled testicles became epidemic among the crew, insomuch that one-third of them was affected at the same time. As the testicles are sometimes affected by translation in cases of mumps, it is necessary to mention that this occurrence did not take place in any of the ten ships, in which the latter prevailed.

7. The surgeon of the Diamond reported, that, in a cruize in the West Indies, forty of the men were taken ill with typhous fever, at a time when none of the circumstances were present, which commonly produce that disease; and he thought, that it probably arose from some of the men being affected with the small pox about that time. One of those in whom it was confluent died. According to the report of the same surgeon, a solitary instance of the scarlet fever appeared about the same time.

8. The surgeon of the Colossus reported, that five of the men were taken ill with the scarlet fever, attended with the usual symptoms of malignant sore throat; that one of them died; that two were sent to a hospital on shore; and that it was prevented from spreading, by destroying the clothes of the men affected, and using other precautions, such as washing their bodies, and fumigations.

9. It is stated in one of the journals of the Windsor Castle, a ninety gun ship, that a dysentery became very general among the men, in consequence of a boy having been brought on board, labouring under that complaint. This is one of many others equally demonstrative of the infectious nature of this disease in certain circumstances.

10. Two cases of plica polonica were reported. One was in a boy, who said he had caught it by sleeping with a person who had it, a short time before he came on board. Of the other no history whatever was given.

It is not meant to affirm that all these examples of the production of disease are instances of the creation of infection, though some of them certainly are. They are intended chiefly to shew how disease may originate in singular concurrences of external circumstances, acting in combination with an internal predisposition tuned as it were in unison with them, such pre-disposition being acquired also by a peculiar concurrence of circumstances.

The next part of this subject which falls to be considered, is that which relates to the means of preventing and extinguishing infection, and the measures best adapted as precautions against its diffusion. The methods of effecting these objects will be readily suggested by the details already given, and may be comprised in the three words, Cleanliness, Ventilation, and Separation. The most common infection upon which we are called upon to practise these methods in this country, is that of typhus. These are now well understood, and have been successfully practised, not only in the metropolis, but in the principal provincial towns of England, but as they cannot be too often repeated nor too extensively diffused, I shall here recite them by transcribing my answer to an application made to me as well as other physicians, whose publick duties led them to the study of this subject, from Newcastle upon Tyne, regarding the methods most advisable to be adopted for ventilation, purification, and separation, with an appeal respecting some difference of opinion concerning the possibility of typhous infections being communicated from contiguous and adjacent buildings to the other patients.

The following was the substance of my answer, dated 14th of June, and 16th of Sept. 1802.

" Having been in the constant habit of considering the subject of infection, both in a moral and medical point of view for the last twenty-three years, from opportunities afforded me, partly in the naval service, partly in one of the largest hospitals of this metropolis, of which I was physician for twelve years of that period, I shall return such an answer to the enquiries as a close and earnest attention to this subject enables me to give.

“ I consider the principal utility of hospitals, as institutions for the alleviation of human misery, to consist in their being places of refuge for destitute strangers, as the word implies, and for being receptacles for preventing the spread of contagion. For as there is a certain limit to charity beyond which it becomes a premium for vice and idleness, I am by no means of opinion that sickness in general occurring among the labouring classes, should be indiscriminately provided for at hospitals, inasmuch as it militates against that mutual dependance and protection, upon which are founded all those domestic endearments and duties which are so essential to the happiness and welfare of society in all its ranks.

“ I cannot therefore but concur with you in approving of the establishing of wards exclusively for the reception of fevers, as long as the present epidemic continues.

“ In addition to the forcible reasonings contained in the papers you have transmitted to me, I will beg to present the subject in another point of view tending farther to recommend this arrangement. From much observation as well as unquestionable testimony, I am well convinced, that, though the fever itself does in certain circumstances generate infection, the most frequent and virulent instances of it originate, not from the fever itself, but among those in health from want of ventilation and cleanliness, combined occasionally with scanty and bad food. My meaning will be best illustrated by an example. In the sessions at the Old Bailey, in the year 1750, so noted for its calamitous consequences, it was remarkable that the prisoners who communicated the contagion were not themselves ill of fever; and it is perhaps still more remarkable, that none of those who were ill of it, to the greater number of whom it proved fatal, communicated it to their families and attendants. It is not to be inferred from this last remark, that these fevers were not infectious, as some have ventured to affirm. It only proves that those who are treated in clean and airy apartments, such as those inhabited by the better sort of people, who were the victims of this infection, do not communicate the disease even to those who are in the constant habit of approaching them. I have invariably made the same remark in those naval and civil hospitals, which I have had a share in directing; and when rare and accidental instances of infection have occured in them, there is reason to suspect that it has been introduced from the original stock of it previously adhering to the clothes or hair of the patient, and not generated in the course of the fever. And when any such fever has occurred in private families in which I attend, I constantly assure the family, without having been once mistaken, that if perfect cleanliness and sweet air are maintained, there is no occasion to dread any communication of the disorder to others.

" In what has been said, a clear answer will be found to the quere regarding the danger of fever being communicated from one ward to another, or from a fever-house situated close to an hospital. Since perfect ventilation and cleanliness were adopted at St. Thomas's Hospital, cases of fever have not communicated it even to patients in the same ward. This was far from being the case in former times, when not only the patients, but the medical and menial attendants were frequently and fatally affected with it. The celebrated Dr. Akenside, the poet, a native of your town, and physician to this hospital, was said to have died of it.

" All this naturally leads to the remark, that during the prevalence of a typhous epidemic, measures should be adopted with the utmost anxiety for striking at the root of the evil, by carrying the methods of purification into the habitations of the poor where the seeds of it exist, and where the first step to be taken, is the removal of the sick. It is needless to inculcate on the medical faculty, and the magistracy of Newcastle, how much *prevention* is superior to *cure* in point of economy as well as humanity. About two years ago an infectious fever broke out in some country parishes about forty miles from London and proved very fatal, particularly to young people; and having spread to those in the upper ranks of life, a nobleman in the neighbourhood consulted me concerning it. I recommended that parochial visitations should be made, in order to establish cleanliness, and ventilation in the habitations of the poor; to supply them with mops and brooms, and, above all things, with a sufficiency of soap; to render the windows moveable where they were fast; and to furnish some articles of bed and body clothing; but in no case to give money, and to find a liberal supply of food only to the poorest, lest they should be rendered too independant of their own exertions. He has since informed me that the plan answered perfectly and had been the means of preventing much misery, and of saving many lives."

Here followed a description of the best methods known of ventilating hospitals; but as these are described at p. 137 of this work, it is unnecessary to repeat them here.

" As it has, I hope, been fully established in evidence that typhous infection may be generated independantly of fever, and that it will not arise in the course of the fever, except in cases of gross neglect, constituting a material difference between this and the infection of the small pox, or plague, so will there be a corresponding difference in the precautionary measures to be adopted in these two species of disease.

" In taking these measures, it is of fundamental importance to ascertain what may be called the sphere of diffusion, and to bear in mind that it is the living human body which is the source of the deleterious vapours, and not the atmosphere. With regard to the plague, no medical man of the most ordinary education can now be misled by so gross an error, but it has been of the most mischievous consequences with regard to those officers of police to whom preventive measures have been entrusted. When it was believed that it proceeded from a contaminated state of the whole atmosphere; the nature of the danger and the means of averting it, were equally misunderstood; for, if the sphere of infection extended to the whole atmosphere, there could be no more danger in the closest approach than at the greatest distance, and the measures adopted under this error, were perfectly futile and unavailing, such as the lighting of large fires in the open air, and the firing of artillery, to the neglect of the rational and efficient means of cleanliness, ventilation, and separation!"

Some readers would perhaps be disappointed if nothing were said about the chemical methods of destroying infection. I mention it last, not from an absolute distrust in the efficacy of the vapours of the mineral acids; but they are applicable only in cases of very rare occurrence, and would be unavailing, unless accompanied with the means already so strongly inculcated. But if this practice should not be suffered to interfere with, nor made to supersede these, there can be no objection to adopt it as an auxiliary.

Among the measures, under the head of precaution, the inoculation for the small pox falls to be mentioned. The first notice we have of this is traceable to a superstitious practice in the East, where it was believed that the buying of the small pox, as they called it, tended to mitigate its violence. The *virus* for inoculation was taken from a pustule, and a piece of money left as the price of it. The genuine physical cause of the superior safety of this to the casual infection is very obscure. It may naturally enough be alleged that when inserted by art, on the surface, it is less likely to produce dangerous effects than when casually caught by the *virus* being applied to the lungs by respiration, or to the stomach by being swallowed. I have seen in the inspection of the dead body evident variolous pustules in the trachea, bronchia, œsophagus, and stomach. This, however, cannot be the sole cause; for, the casual small pox is sometimes as mild as the inoculated, and the inoculated sometimes as malignant as the casual. This may be partly ascribed to the great diversity of constitutions; for in some, the susceptibility is so great, and the tendency to malignity so uncontrollable, that if the whole species were similarly constituted the human race would infallibly be extinguished. But it is farther observable that the same individual is differently susceptible at different moments; for it is well known that a person who has at one time been exposed to strong casual infection has escaped it: and at another, has caught the disease from an exposure so slight as not to be traceable. In reasoning upon this, it seems conceivable, and even probable, that as casual infection is taken in by the inhalants, which are not always in an absorbent state, or humour, and may in a healthy state of the body reject extraneous and acrimonious matter, agreeably to that elective power, which these vessels are alleged to possess, so they will imbibe it when in a less healthy state, and when the body is prone to fall into disease. If this is admitted, it will account for the greater danger of the morbid action, when this arises from the spontaneous inhalation of the poison, than when it is obtruded by art; and it will also account for the inoculation proving sometimes as fatal as the casual disease; for, the artificial insertion must occasionally coincide with the fit of morbid propensity which gives effect to the casual infection.

This mode of mitigating the most dreadful of all epidemics, however curious and admirable, has proved of no substantial benefit; for, though it has saved the lives of a small portion of the community, it has encreased the general mortality. Nor could any practicable means of separation have ever subdued this greatest foe of the human race. This was reserved for vaccination, a discovery which affects the destinies of mankind more than any other medical improvement that was ever made, and cannot fail to impress us with a high opinion of the value of researches into the secret ways of Nature; for, there may be other undetected truths still lurking under her very surface, which if brought to light, may be of the utmost avail to our best interests.

The only question now remaining to be touched upon regards the discrimination of disorders which are contagious, from those which are not so.

There is a great diversity in the causes by which multitudes of human beings come to be afflicted with the same malady at the same time and in the same place. 1st, Contagion, of which small pox may be taken as the most simple architype, or representative. 2dly, A community of circumstances in point of diet and other conditions, whether natural, as in the water, or artificial, as in the quantity and quality of food, also fatigue and exposure to the weather. Among those proceeding from water, may be reckoned the swelled leg of Barbadoes and Cochin, and the Cretinism of the Alps. Of those proceeding from scanty and bad food, the typhous fever may serve for an example, and of those caused by fatigue and exposure, various febrile affections, such as inflammatory fevers, acute rheumatism, and pneumonia constitute the most important heads. 3rdly, The temperature of the air, and the seasons of the year. Of these, the bilious fevers and cholera occurring chiefly in hot climates, or the hot seasons of temperate climates; also the pulmonic inflammations of the vernal season, and the bilious affections of the autumnal season in our own climate compose the greater part. 4thly, The most common of all, and the most accurately defined, is the intermittent fever found to exist only in marshy and woody districts, as exemplified in Zealand and in the eastern counties of England, and the remittent, as exemplified in the jungle fever of India, the malignant fever of Batavia, and the simple form of the yellow fever in the Carribean islands. All these proceed from a soil from which certain poisonous exhalations of an unknown and incoercible nature emanate and contaminate the atmosphere.

These causes sometimes act alone, but frequently in conjunction, and this seems to have been the chief cause of the ambiguity which has given rise to so much controversy. It is the casual mixture of infection, generated by, and proceeding from the living human body, and causing *epidemic* complaints, with those which are generated by, and proceed from certain characters of soil, and causing *endemic* complaints.

In order to pave the way for an accurate discrimination of these, it will be expedient to mark, first, the principal points of difference which exist between them; and then what they have in common.

The first and main difference consists in the former being extremely various, and infinitely irregular, as has been so fully explained in the course of this Dissertation; whereas the latter is quite simple in itself, and in the disease to which it gives rise. 2ndly, The one is transportable by the matter of it adhering to the human person, or other substance; whereas the other is so evanescent that it cannot either be arrested or conveyed beyond its own atmospheric range. 3dly, That in the nature of things, the diffusion of the one, must be *progressive* in time and space whether transferred from one human subject to another, or on other substances, in the form of *fomites*; whereas, the other being equally diffused in the atmosphere, must be inhaled every moment by the population at large, and will therefore make its appearance *simultaneously* in different places of the district in which it exists.

The only properties which they have in common, which fall to be noticed as they affect this question, are, first, that none of them affect the whole population who are exposed to them; and, 2ndly, That they affect different individuals with very different degrees of severity. The first of these, is of high importance in the controversy alluded to; for, it has been usual with those who deny contagion, to allege that great numbers are known to be exposed to it without catching the disorder; and this they have proclaimed in a triumphant tone, as if it were unanswerable. What but that blind zeal which animates partisans, could prevent them from seeing that this fact argues much more strongly for the other side; for if the cause existed in the atmosphere, every living creature at every moment and in every spot must be exposed to its action; whereas it is quite conceivable that the morbid poison generated by a living body may never be applied to those who, at various distances, surround the infected individuals. The truth is, that it has pleased Almighty God in his mercy to smite only a certain proportion of those exposed either to the one or the other, and many of them in a degree short of fatality, otherwise the human species might be extinguished.

These are the leading principles, if I mistake not, upon which questions of this nature are to be decided.

There is one other general remark which it is useful to mention, namely, that as the miasma of the soil is extremely simple, and the diseases of infection extremely capricious and anomalous, it is much more probable, considering the matter abstractedly and *a priori*, that, in a questionable case, contagion should have a share in it, than that the other should be the exclusive cause. For instance, no one ever suspected that the agues of Zealand or England were infectious, and one does not see how any such suspicion could, without some substantial reason, attach to the yellow fever, if it were in all cases purely endemic, like the European ague. But as this fever has been the great *arena* of controversy, any farther discussion on this subject shall be deferred till it comes to be considered in a subsequent article.

There are two other epidemics which have also been the subject of controversy, and over which there seems to hang still greater ambiguity. These are the spasmodic cholera of India, and those influenzas or epidemic catarrhs which have been noticed in the records of physic for several centuries past, as extending themselves at shorter or longer intervals over large portions of the habitable world on both sides of the Atlantic.

The former made its first appearance at a place called Jessore, about 100 miles to the N. E. of Calcutta, in August, 1817, and spreading from village to village, reached Calcutta in the following month. How it originated at Jessore is matter of uncertainty, but the most probable conjecture is, that it must have been generated by some such fortuitous concurrence of circumstances as has been noticed in a former part of this Dissertation. From Calcutta it spread up the Ganges, making the most tragical desolation, till it reached the grand army assembling in Upper India. In this progress its course was in a direction opposite to that of the periodical winds which prevail at that season. It continued its course through the countries invaded by the army, and reached Bombay in September, 1818, one year after it first appeared at Calcutta. From thence it spread across the peninsula of India till it reached Ceylon in January 1819. About the same time it crossed the Bay of Bengal, and spread its ravages in farther India, and through various countries and islands till it reached China. In the following year it reached Persia in all its horrors. But one of the most remarkable and interesting incidents regarding its progress is that, in 1819, it made its appearance in the island of Mauritius near 3000 miles from the coasts of India. This happened immediately after the arrival of the Topaze frigate from Ceylon, and this ship had lost several of her men by this disease. Now, it would appear on a superficial view that this had some connexion with the frigate, or why, it may be asked, might not this disease have broken out at any other spot on the earth or ocean at the same distance from India? But it does not appear that it did: so that its appearance at that time, in this little island, must have been a mere casual co-incidence, unless infection is admitted. But neither this, nor any, nor all the facts here recited have been admitted to be decisive of the question. On the contrary, there are many gentlemen as well, or better informed, than myself, and more capable perhaps of judging in the case, who sturdily maintain that it cannot be contagious. I am bound, therefore, to deliver my opinion with becoming diffidence, and to leave its final decision to those who may receive still clearer lights on the subject.

With regard to the influenza, of which, according to Dr. Haygarth, there are four hundred instances on record, its spread has been so wide and so rapid, as to afford the highest presumption of its not being contagious. According to some accounts, its attack has either been simultaneous in distant places, or so rapid as to make it inconceivable how it could be conveyed by human intercourse:* while others have reported that they could trace its local progress. There are no grounds for impeaching the fidelity of either of these testimonies. Nature seems as it were to be inconsistent with herself. But neither can this be the case; so that in concluding this Dissertation, as in commencing it, I have found difficulties with which I confess myself to be unable to grapple. And were I to attempt a solution of them, I should run the risk of making such a botch of this sublunary subject, as Ptolemy the geographer made in his celestial system. Believing, however, as I do, in the wisdom of the Author of Nature, I shall not be betrayed into the same impiety of expression as is imputed to king

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* The principal influenzas recorded by English authors have been those of 1732, 1762, 1775, 1782, 1803. Some of the best accounts of them are to be found in 3d vol. of the Medical Transactions of the College of Physicians, and the 6th vol. of the London Medical Observations. Its duration in them all is stated to have been from a month to six weeks.

Alfonso the Wise,* in studying the cycles and epicycles of the Ptolemaic system. Let us rather hope that in the lapse of ages another Copernicus shall arise, who will vindicate the consistency of Providence in the disposal of the human destinies, as has been done in expounding the mechanism of the heavens.

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* That he himself could have made a better disposition of the movements of the sun, moon, and planets.

DISSERTATION VIII.

On Muscular Motion; being the Substance of the Croonian Lecture. Read before the Royal Society, by the appointment of the President and Council, on the 13*th and* 20*th November*, 1788.

Importance of the subject—Extensive influence of Muscular power in the animal economy—Properties of a Muscle in its dead state—Considered in relation to other motions—Motion an original property of all matter—Proofs of the inherently active nature of all matter—Mechanical impulse cannot be a primary cause of motion—Hypothesis of Attraction and Repulsion constituting the essence of matter—Muscular motion cannot depend on any mechanical cause—But an original law of Nature—Proofs of its encreasing the power of cohesion—Experiment—Whether Muscular contraction encreases density—Experiments—Contraction produces no change of density — nor of temperature—Recapitulation—A Theory of Muscular contraction—Enumeration of *stimuli*—1. Internal *stimuli* —All the functions of the body carried on by specific *stimuli*—Application of this to the resuscitation of life — And to Pathology—Exemplified in the absorbents—Analogy between motion and sensation—Whether vitality is dependent on the Nervous System—The mutual dependance of simple life and nervous influence—Essential properties of simple life—Nervous influence unfriendly to simple life—This illustrated by observations on fish—on quadrupeds—and by diseases—Fatigue—Sleep—Effects of immoderate labour, and of sensuality—The practical benefit of removing irritation—*stimuli* connected with consciousness—Effects of the Passions on muscular fibres—2. External stimuli—Instinct—Habit—Correspondance between the properties and laws of external Natur and the faculties of animals—Imitation—Necessity of Tension—its excess and defect as producing disease—Muscular Motion considered mechanically—The strength and stature of the body adapted to external nature—Advantage and disadvantage of their insertions and obliquity—Advantage of obliquity demonstrated by a geometrical theorem.—Conclusion.

THIS Lecture was founded by Dr. Croone, who was one of the original Fellows of the Royal Society, having been previously a member of those private meetings which laid the foundation of this institution. He was not only a physician of learning and eminence, but his character for taste, as well as for mathematical and natural knowledge, was so distinguished, that he was elected Professor of Rhetoric in Gresham College,* and was appointed a member of the first council of the Royal Society. What prompted him to perpetuate and keep alive an attention to this subject was, no doubt, an opinion of its importance and difficulty. There are certain branches of knowledge which, being considered as belonging to particular professions, appear less interesting to men who entertain a taste for general science; and this has in some measure been the case with inquiries relating to the animal œconomy. But when we consider the rank which animated beings hold in the scale of Nature, and that Muscular Motion involves some of the most important circumstances relating to them, it cannot be denied that this is a subject highly interesting, as a branch of natural knowledge in general, independent of its utility as subservient to medicine. For, though sensitive beings bear no assignable proportion to the great volume of the material world, yet as man belongs to this class of existence, and as all other existence would seem to be created in vain, unless there were beings capable of perception and enjoyment, the investigation of animal nature appears to be of the utmost importance, not only as the grounds of a useful art, but as an object of a philosophical curiosity, as intense and interesting as any in the compass of universal Nature.

Muscular motion is justly deemed an important and a characteristic attribute of animated beings, not only as conferring that loco-motive faculty peculiar to animals, and that power by which they are enabled to exercise a command over external objects, but also as it constitutes that energy by which the motion of the fluids and all the internal functions of the body are carried on. For, we are to consider as muscular not only those large masses of flesh which compose so great a proportion of the whole bulk of the body, but likewise all the minuter organs subservient to circulation, nutrition, and secretion; since not only the heart itself, but the whole vascular system and the intestines, owe their action to certain powers of irritability and contractility peculiar to living fibres, all referable to one class of organs.*

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* See Ward's Lives of the Gresham Professors.

In investigating this subject, it seems most natural to begin by comparing the muscles, and the motion belonging to them, to other modifications of matter and motion that occur in nature.

A muscle, even in so far as its structure is an object of our senses in its dead state, has characters which distinguish it from every other substance in nature. The most striking of these, is its regular organization of parallel fibres. The fibrous structure is, indeed, found in other parts of the body, such as the tendons and ligaments, and also in vegetables, some of which are even possessed of visible irritability; and a similar conformation is manifest in some minerals, such as the *asbestos*; but there is a certain degree of tenacity, elasticity, and moisture, which, joined to its fibrous organization, distinguish it from every other form of matter. With regard to the minute structure of muscles, though some have fancied they have seen, by the help of glasses, the ultimate fibres, and these consisting either of hollow tubes, or strings of vesicles, or rhomboidal articulations, according to the respective theory with which the mind of the observer was prepossessed, it appears, from the best microscopical observations, that the fibres are divisible beyond what the powers of the best assisted sight can trace, and that they are to all appearance uniform.*

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* Since this was first written, some physiologists have questioned the propriety of calling vascular and membraneous organs muscular, though possessed of living contractility, on account of their chemical composition being different from that of the organs commonly denominated muscles. This seems to be a matter of mere arrangement and definition, and the sense in which I wish to employ the term,

This regular fibrous structure of muscles, though effected by powers peculiar to life, may be compared to the crystallisation of salts, and other regular forms which inanimate bodies assume, when passing to a solid form from a state of solution or fusion. Every species of matter has a mode of aggregation peculiar to itself, when its particles are at liberty to attract each other according to that tendency which has been called their *polarity.* Those who first conceived this idea, seemed to have proceeded on the supposition of the ultimate particles of matter being solid bodies, infinitely hard, having their different sides endowed with different powers of attraction and repulsion, so as to give various configurations to the parts of matter, when concreting into a solid form. There is a still more profound doctrine on this subject, founded on the hypothesis of the ultimate particles of matter being combinations of attracting and repelling points, which when brought much within the natural limits of these powers, produce unequal degrees of attraction and repulsion at equal distances from their common centre, thereby defining what may be called the shape of the particles, and constituting polarity.† In whatever manner we conceive this to take place, some such circumstance seems universal, and perhaps necessary to all the varieties of solid matter; and there is in some instances a difference in the appearance and other properties of the same substance, after passing from a fluid to a solid form, accord-

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includes all fibres which possess the power of contracting themselves in virtue of their vital power, as distinguished from mechanical power, whatever their chemical elements may be.

[*] Some new light has been thrown on this subject, since this Lecture was first published. See an article by Sir Everard Home in the Phil. Trans. for 1818.

[†] See Dr. Blagden's Experiments on the cooling of Water below its freezing point. Phil. Trans. Vol. LXXVIII. page 143.

ing as its particles have been at liberty to follow more or less freely the tendency of their polarity in the act of concretion. This may be illustrated by the freezing of water, and the crystallisation of salts, which are more or less regular or confused, according to the circumstances in which they have taken place. The same may be exemplified in metals and other substances; for it is well known, that the properties of iron and glass, in point of cohesion and elasticity, are very much affected by the quickness or slowness with which they pass from a state of fusion to a state of solidity. It is probably in some circumstance of this kind that muscles differ from other soft animal matter. We cannot trace, by inspection, the manner in which the fluid nutritious matter is ultimately *applied* in forming solid parts; but as muscles are composed of parts so regularly figured and endowed with contractility, it seems probable that there is some provision made by Nature, whereby the particles follow the precise tendency of their polarity, and constitute a more exquisite structure than in other parts of the body.

So far with regard to the character of a muscle, considered in its dead state.

The first circumstance that meets the attention in considering its living state, is that contractile power or motion, which is properly the subject of this Lecture; and in order to investigate its nature, it will be necessary to compare it with that which takes place in inanimate bodies, by considering the nature of motion in general.

So far as we know, either from actual observation, or from analogy, there does not exist in nature any such thing as absolute *rest:* for when we contemplate the motions of the earth and heavenly bodies, the various complications of the planetary revolutions in their rotation round their own axes, and in the paths of their orbits, in the irregularities arising from the disturbances of their mutual gravitation, and from the precession of the equinoxes, not to mention the influence of the innumerable sidereal systems upon each other,* it may be affirmed, on incontestible principles, that no particle of matter ever was, or will be, for two instants of time, in the same place, and that no particle of it ever has returned, or will return, to any one point of absolute space which it has ever formerly occupied. Whether motion, therefore, can strictly be called an *essential* property of matter or not, it is, certainly, by the actual constitution of nature, originally and indefeasibly impressed upon it; and as rest does not exist in nature, but may be considered, in a vulgar sense, as a fallacy of the senses, and in a philosophical sense, as an abstraction of the mind, it follows, that what is called the *vis inertiæ* of matter, is not a resistance to a change from rest to motion, or from motion to rest, but a resistance to acceleration or retardation, or to change of direction. If it should be alleged, that any given particle or portion of matter is carried along by virtue of the motion of the planet to which it belongs, it may be answered, that the earth or any other planet is nothing more than a congeries of such particles, each of which must possess a share of the same energy which animates the whole mass.

The active nature of matter is farther proved by those attractions and repulsions which universally take place among its parts, however near or remote; and every instance of motion within the cognizance of our senses, in the bodies around us, is referable, either in itself or its cause, to some mode of attraction or repulsion. Mechanical impulse being the most familiar cause of motion in the ordinary events of life, is apt to be considered as the most simple and original cause of it; but it is obvious, upon reflection, that it cannot originate in itself, and that all collisions are produced either by the efficiency of living animals, that is, by muscular action, or by means of some operation of nature, depending on attraction or repulsion. Of the first kind, all the mechanical operations of art are examples; and with regard to the others, they may, if carefully investigated, be referred in every instance, either immediately or remotely, to the above-mentioned inherent energies of matter. The natural agitation of air or water, for instance, may produce motion by impulse, or may bring two solid bodies to impinge upon each other; but it is evident that all such-like motions in the atmosphere or the ocean, could not take place without gravitation, which is one of the attractive powers of matter. From the familiarity of impulse in the common experience of life in external nature, we imagine that we have a more clear conception of it as a cause of motion, than we have of gravitation, electricity, or magnetism. The difficulty of conceiving these, consists in the apparent impossibility of a body acting where it is not actually present. But a little reflection will make it clear that the same difficulty exists with regard to impulse; for it is demonstrable from the phenomena of expansion and contraction of bodies by different degrees of temperature, that there can be no such thing in nature as the absolute contact of the ultimate particles of matter. It follows that in the act of impulse, the particles of matter must act upon each other at a certain distance.

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* See Dr. Herschel's Paper on the Construction of the Heavens. Phil. Trans. Vol. LXXV. page 231.

Attraction and repulsion may be considered as one principle, inasmuch as they are both expressive of that active state originally inherent in matter, and because any two particles acting upon each other, either attract or repel, according to their distance, their temperature and affinities; and this is so universal an agent in nature, that some modern philosophers have made it absorb, as it were, every other power and property of matter. The late father Boscovich,* of Milan, about forty years ago, advanced a very bold doctrine to this effect, alleging with great strength of argument, illustrated by geometrical reasoning, that there does not exist in nature any such thing as impenetrable extended particles; and he deduces all the phenomena of the material world from one principle, which supposes it constituted of points having several spheres of attraction and repulsion, which being variously arranged and combined, produce the different forms and properties of matter, and its several powers of attraction, whether chemical affinity, cohesion, or gravitation. Whether this hypothesis is founded in truth or not, it would appear from the reasonings made use of, that all the relative properties of matter may be accounted for, though we abstract from every other consideration but attraction and repulsion.

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* See this doctrine fully explained, in a work entitled, *Theoria nova Philosophiæ naturalis redacta ad unicam legem, &c. Auctore Rogerio Boscovich. Venetiis,* 1763.

It is evident, therefore, that whatever may be the cause of muscular motion, it is not referable to mechanism, which is itself only a secondary principle. Some theories have had recourse to the conveyance of a fluid into the fibres of muscles, by which they were swelled, and thereby shortened. One of the most plausible of these hypotheses supposes this fluid to be the blood; but this is plainly a *petitio principii;* for in order to give motion to the blood, the very power in question is necessary. Other fluids have been supposed to have this effect, but even the existence of these has not been proved. I will not detain this learned audience with a recital of the numerous theories of this kind that have been invented by fanciful and ingenious men, only *one* of which can be true, and the most solid objections could be urged against them all. Other arguments, derived from the nature of irritability and sensibility, could, if necessary, be brought to prove that muscular motion cannot depend on any mechanical cause: but this part of the subject was fully treated of by the ingenious gentleman who delivered the Croonian Lecture last year.

As it has been proved that all matter is in a state of perpetual motion, originally impressed upon it by Nature, also that attraction and repulsion are essential to it, and the ultimate causes of all new motions that can arise in the universe, mechanical action being only a secondary cause, it seems most agreeable to the analogy of nature, to refer muscular motion to an original law of animated matter, whereby its particles are endowed with an attractive power for which no cause can be assigned, any more than for gravitation, cohesion, or chemical affinity. If I understand it aright, this was the doctrine laid down and illustrated last year by Doctor Fordyce, and to which I am endeavouring to contribute some additional proofs and illustrations, from a conviction, that it is the only rational and philosophical light in which this subject has hitherto been viewed.

The peculiarities of muscular attraction, as distinguished from every other instance of it in nature, shall be the first object of my research. If the shortening of a muscular fibre depends on this encreased power of attraction between its particles, the effect of it will be to add to the power of cohesion in the fibre; and if this shall be found in fact to be the case, it will be a farther proof of the doctrine just now advanced. In order to decide this, I made the following experiment upon the flexor muscle of the thumb of a man, five hours after death, while the parts were yet warm and flexible. All the parts of the joint having been separated, except the tendon, a weight was hung to it, so as to act in the natural direction, and was increased gradually till the muscle broke, which happened when twenty-six pound had been appended. I found that a man of the same age, and the same apparent size and strength, with the subject of the preceding experiment, could with ease lift thirty-eight pounds by the voluntary exertion of the same muscle. It is farther in proof of this fact, that in the case of a violent strain from muscular contraction in the living body, it is the tendon that gives way, whereas we have seen, in the experiment just now related, that in the dead body, the muscle is the weaker of the two. It is also well known, that in cases of over-exertion, the muscular fibres themselves do not give way, though the strongest tendons, such as the *tendo Achillis*, and even bones, such as the knee-pan, are broke by their living force,* which, in such instances, must be many times greater than the strength of the dead fibres.

The sensible increase of hardness in a muscle, when in a state of contraction, may also be considered as a proof of an increased attraction of its particles to each other at that time.

In investigating this subject farther, it is of importance to determine, whether or not a muscle, when in a state of contraction, undergoes any change of density. A comparison of it in this respect with dead matter, may throw some light on the nature of muscular action.

Every homogenous body possesses a certain degree of density, determined by the distance of its integrant particles. The most common means in nature, by which the density of such bodies is altered, are heat and cold; the one universally producing expansion, the other condensation. Mechanical force has an effect in adding to the density of some species of matter, as is found in the hammering of iron; but it has not been ascertained by experiment, as far as I know, whether the forcible extension of bodies has any effect in diminishing their density. In the elongation of an elastic chord, it is evident that there must be an encreased distance of the particles in one dimension, but as this may be compensated by a contrary change in the other dimension, the question regarding the change of density can be decided only by experiment. And as this is the point with regard to inanimate matter, which bears a seeming analogy to muscular motion, I thought it worth while to institute an experiment, to decide it. I took a piece of the elastic gum, or *kahoutchouk*, three inches square, and about the eighth of an inch in thickness; I procured a piece of sheet-tin, three inches broad, and six inches long, cut into sharp teeth at each end. The gum was first weighed in air, and found to be 380.25 grains. It was then weighed in water, along with the tin, to which it was loosely attached, and the weight of both was then 758,75 grains. The gum was then stretched upon the tin, by means of the teeth at each end, to a surface of about five inches square, the tin being bent so as to leave a free space between it and the gum, in order that when immersed in the water, no air bubbles might be entangled. In this situation, the weight of both in water was found to be 746,75 grains. Here was a difference of twelve grains, which could be owing only to a diminution of specific gravity; and in order to be sure that there was no fallacy nor inaccuracy in the experiment, the gum was immediately after disengaged from one end of the tin, so as to allow it to shrink, and being again weighed in this state in the water, it was found to have recovered exactly its former weight. This, as well as the subsequent statical experiments, was performed by means of the exquisite balance lately invented and constructed by Mr. Ramsden, and belonging to Sir Joseph Banks, who politely allowed me the use of it. I was also assisted by Mr. Gilpin, clerk of the Royal Society, who is extremely accurate and expert in all operations of this kind.

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* There is a case related in the Philosophical Transactions, by Mr. Amyand, wherein the *os humeri* was broken by an exertion of the muscles, see Phil. Trans. Vol. XLIII. page 252. Every one has observed or heard of fractures happening from very slight accidents. These occur most probably from a jerk of the muscles concurring with the external violence. An accident in illustration of this happened a few days before this was written, (June, 1822), a nobleman about fifty-five years of age, by striking his foot against the foot of a skreen, was made to stumble and fall on his side. It was found that the os femoris was fractured, but not on the side on which he fell, so that the fracture could not be imputable to any external impulse, but purely to the muscular action, excited by the instinctive effort to save himself from falling.

Now, does the state of relaxation and contraction make in like manner a temporary difference in the density of muscles? When the circumstance of *decurtation* only is considered, we should be tempted to think that there must be an approximation of the particles of the fibre; but there is at the same time a lateral swelling of the muscle, which may compensate for what is lost in the other dimension. This point cannot be decided but by an experimental examination. It might be determined whether a muscle occupies most space when relaxed or when contracted, by finding its specific gravity in each of these states by means of the hydrostatical balance. But this would be found extremely difficult; for the state of contraction is very transitory, and the motion itself would produce such a disturbance, as would render the result unsatisfactory. As there is this obstacle to the experiment on a living muscle, it occurred to me that it might be performed on the muscles of a fish, which had undergone the operation of *crimping*, as it is called; for, in consequence of dividing the muscles, by cutting them when alive, they undergo a contraction, which continues after death;* and upon comparing, by the hydrostatic balance, portions of muscle which had been crimpt, with those of the opposite side of the same fish, which had on purpose been saved from this operation, it did not appear that there was any difference in the specific gravity. Two trials were made, one with the masseter muscles of a skate, the other with the sides of a large trout.

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* It has been made a question, whether life, and its actions, may not affect the *absolute* gravity of bodies? Though this doubt has not arisen upon any assignable grounds that I know of, unless it be that one unknown principle may affect another equally unknown, I thought it might be worth while to determine it by experiment. The first trials were with animals of warm blood inclosed in oilskin, and close tin vessels; but not being satisfied with the accuracy of these, from the difficulty of cutting off all communication with the external air, so as to prevent moisture from exhaling, I inclosed live eels in flasks, and sealed them hermetically; and, in this situation, their weight

The following experiment was also made, in order to decide the comparative density of a contracted and relaxed muscle. I took a glass flask, into which one half of a living eel was introduced. The mouth was immediately afterwards fused by a blow-pipe, and drawn into a tube like the stem of a thermometer. The flask and tube were then filled with water, in order to see whether the motion of the animal would make the fluid rise or fall. It had neither the one effect nor the other, though there were at times strong convulsions, and if the muscles had at any one time occupied either more space or less than at another, a sensible fluctuation would have been produced, especially when the column of fluid was rendered very fine, by the introduction of a steel wire to irritate the parts. That part of the eel from the *anus* to the tail was made use of for this experiment, as the other division, containing the organs of respiration and the air-bladder, might have occasioned a fallacy, from the expansion or condensation of an elastic fluid, by accidental changes of temperature, or compression. This was repeated three times, with the same result. In one of the trials, the above mentioned portion of two eels was introduced, and though they were at times both in convulsions at once, not the least motion of the fluid in the tube could be perceived.

I was the more desirous to be accurate in this and the preceding experiments, as the result of them was different

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when alive being compared with their weight when dead, there did not appear any reason to suspect that the mere circumstance of life made any difference in regard to gravity.

from my own preconception at the time, and different, I believe, from the opinion of most modern physiologists. It may safely be inferred from them, that the contraction of a muscle produces no change in its density, and that animal life differs from inanimate matter in this respect, as well as in most of its other properties and laws. One purpose in nature for muscles always preserving the same density may be, that as some of them act in confined cavities, inconvenience might arise from their occupying more space at one time than another. In the extremities of crustaceous animals, for instance, which are filled with muscles, a change of density could not fail to burst them. This may also be considered as a proof of the fact itself.

Another circumstance in which the contraction of muscles differs from simple elasticity is, that the former, however frequent and violent, does not produce any heat, as collision and tension are known to do. I found that a very sensible degree of heat was produced by the quickly repeated extension and relaxation of a piece of elastic gum; but it is not found that the like repetition of action in a living muscle has the same effect. This may admit of some cavil with regard to animals of warm blood; for, one of the theories with regard to animal heat is, that it arises from the perpetual vibration of muscular fibres, particularly those of the vascular system; but this will not hold with respect to animals of cold blood, in which the actions of life are equally vigorous.

The principal phænomena, therefore, of muscular motion, are the shortening of the fibres, the lateral swell, the increase of cohesion and hardness, and the unchanged density and temperature. It would appear, from the two last circumstances, that the intimate motions of the particles in relation to each other, must be different from what take place in the several instances of contraction and expansion in inanimate matter. In the expansion arising from the action of heat, and the contraction from cold, the change of density shews that in the one case, the ultimate particles must recede from each other; and in the other case, that they must approach. The same may be said of elasticity. But as there is no alteration of the density of a muscle in passing from relaxation to contraction, this change cannot consist in the approximation of the integrant parts of the fibres, but must depend on some other circumstance in the intimate disposition of the particles. In attempting to conceive in what this consists, the following explanation may be offered: It was formerly mentioned that the regular structure of solid bodies depended on the polarity and shape of their integrant parts. Now, all bodies, except such as are spherical, must have a long and a short axis; and let us imagine the fibres of muscles to be composed of sphæroidal particles; we may then conceive relaxation to consist in their being disposed with their long axis in the line of the fibres, and contraction to consist in their short axis being disposed more or less in that direction. This will not only account for the decurtation, and uniform density, but for the lateral swell, and also for the increased hardness and cohesion; for though the particles do not approach or recede, as in bodies simply elastic, yet their power of attraction will be increased by their centres being brought nearer, and by being applied to each other by more oblate surfaces. This hypothesis accords with what has been before proved, concerning the unchangeable density; for what is lost in one dimension, is gained in another; and the cause for there being no increase of temperature, depends probably on the same circumstance by which the density is preserved unaltered.

What has been hitherto advanced on this subject, has tended only to explain that state of a muscular fibre which renders it susceptible of contraction, and to ascertain the nature of that change which takes place in its passing from the state of relaxation to that of contraction. It still remains a question by what efficient power this contraction is excited. We have, indeed, referred the cause to attraction; but of attractions some are perpetual, such as gravitation, which exerts an equal and unremitting *nisus* upon every particle of matter, which is the subject of its action; and there are others fugitive and occasional, such as electricity and magnetism, and we may add muscular contraction. With regard to the first kind, as it is always uniform, it seems sufficient to say, that it exists as a part of the invariable constitution of nature; but with regard to those which are fluctuating, it seems incumbent on those who search into the laws of nature, to say by what mode of efficiency the attraction is performed, so that its action should take place at one time, and not at another. In order to answer this question, with regard to muscular motion, we ought to be able to specify by what mode of operation a *stimulus* excites contraction. Those theories which account for the contraction of muscles, by the swelling of the fibres, in consequence of a conveyance of matter, professed to account for the manner in which *stimuli* operate. But upon the principles I have adopted in this lecture, I am obliged to confess my entire ignorance on this subject. Perhaps it is inscrutable. Perhaps the state of human knowledge is not ripe for such an inquiry; for we are still in the dark with regard to most of those properties of matter which bear any analogy to this, and the knowledge of which might tend to throw light upon it. All that department of philosophy which relates to the corpuscular changes of matter, and the influence excited upon them by what have been called the *imponderable* fluids, that is, heat, light, electricity, and magnetism, to which may be added gravitation, is extremely obscure and unsettled. It is not even decided whether they are really *matter*, or only certain modes of action. We ought not to wonder then that the equally subtle cause of muscular motion should be equally dark and unfathomable;

and as the most chaste and correct philosophers have agreed to assume the former as ultimate principles of nature, let us do the like with regard to that animal attraction in which muscular contraction consists. And the exciting causes of these motions called *stimuli*, being equally inscrutable as to their mode of action, let us restrict our attention to what is palpable and practical, namely, their history and results.

In prosecuting this history, the first thing that naturally occurs to be done is to enumerate the *stimuli.*—They may be divided into internal and external. As an example of the former, the circulation of the blood may be mentioned; as this is kept up by an exciting influence of the blood upon the heart and vessels which contain and impel it. The earliest perceivable instance of muscular motion, is the beating of the heart, as it is seen in the first rudiments of the embryo in an egg, and called the *punctum saliens.* There seems to be established by nature, a certain *habitude* of action between the vessels and their fluids, whereby the former are duly stimulated to propel the latter. This does not depend merely on the acrimony of the fluids; for if a fluid even more mild than the blood, such as milk, be injected into the circulation, it will produce great disturbance; and the property imparted to the blood, by oxygene through respiration, whereby it supports life by stimulating the heart, is of a specific nature, and distinct from simple acrimony.

The irritability of all the containing parts, is in like manner accommodated to the nature of their respective contents. The intestines are so calculated, as to have proper motions excited in them by the aliment, and the secretions which are mixed with it; and there are bodies which, though perfectly mild, such as alimentary substances of difficult digestion, yet excite more violent commotions in the stomach than other substances which are very acrimonious. The various effects of poisons in different parts of the body, may also be mentioned as an illustration of the susceptibility peculiar to the several organs of the body. The poison of a viper, for instance, is perfectly innocent, not only in the receptacles of the animal which produces it, but it may be taken into the stomach of any animal without the least bad effect, and only exerts its deleterious power when brought in contact with a wounded part. Some vegetable poisons, on the contrary, such as that of laurel water,* prove deadly, when taken into the mouth, or applied to any part of the alimentary canal, but are innocent when injected into the veins. The same principle might be illustrated by the operation of various medicines, some of which act upon one set of organs, and some upon another. But it is meant here more particularly to elucidate the natural internal actions of the body; and it may be remarked, that the receptacles of the several secreted fluids, such as the gall bladder, and bladder of urine, are so adapted to their natural contents, by a due measure of irritability, as to bear their accumulation to a certain degree, and then to expel them. We have here also a proof that irritability is not in proportion to sensibility; for both these receptacles are extremely sensible to pain and irritation, from extraneous acrimony, though so moderately sensible to the acrimony of their natural contents. This disposition in the several organs to perform their natural functions, in consequence of the *stimulus* of the respective fluids they contain, has aptly enough been called the specific *perception* of these organs.†

It follows from this, that the application of chemical and mechanical *stimuli* to irritable parts, is not a mode of experiment likely to be productive of useful knowledge, since the internal organs are calculated to perform their actions in consequence of peculiar and specific *stimuli*, provided by nature; and this consideration may serve to suggest the most likely means of restoring lost irritability and action to the vital functions, when suspended by suffocation, strangulation, or submersion. The action of the heart depends on the action of the lungs and the inspiration of atmospheric air; and I have found, from repeated experiments on animals, that in such cases, all other means of restoring circulation and life, are of little or no avail, in comparison of inflating the lungs with atmospheric air, and by stroking and pressing the ribs, so as to imitate the action of respiration. It is singular that this should have escaped the attention of those who have drawn up directions for the restoration of drowned persons. Neither mechanical friction, nor any other external *stimulus*, nor stimulating clysters, seem to have any sensible effect in recalling life. The only other means, besides those above mentioned, that seem material in attempting to restore suspended animation, is a due attention to the external temperature. In the case of drowning in cold water, for instance, it is of the utmost consequence to restore the natural warmth, either by the cautious use of artificial heat, or the application of living bodies. In the case of those who have been suffocated by unwholesome vapor, it is on the contrary, advisable to expose them to cool air, and to dash cold water upon them.

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* See Experiments on Poisons, by Abbé Fontana.

† This idea is well illustrated by Mr. Hunter in his lectures; also by Mr. Mudge, in a dissertation on the *vis vitæ*, subjoined to a tract, entitled, "A radical and expeditious cure for a catarrhous cough."

From what has been before advanced, concerning this habitude or mutual influence of the solids and fluids, it would appear that they are specifically appropriated to each other, in order to carry on not only the circulation, but the important functions of digestion, absorption, secretion, and excretion; and as the healthy condition of an animal consists in the maintenance of that natural harmony, so must the state of disease depend on the derangement of those delicate impressions and nice sensibilities, or rather *irritabilities*, in which the functions of the several organs consist; and as the affections of the solids and fluids are reciprocal, disease may depend either on some deviation of the former from their healthy and natural perceptions, or from some acrimony or vitiation of the latter, or perhaps more commonly from the concurrence of both, in consequence of their mutual influence. But as the vitiation of the fluids is referable to the morbid action of the solids, the specific qualities of all the fluids being determined by the vital action of the secretory organs, the solids must be the original seat and cause of disease, and remedies intended to produce a radical effect must be addressed to them. Nevertheless, as many of the symptoms of disease depend on the acrimony and vitiated state of the fluids producing considerable suffering and disturbance, one of the principal objects of practice will consist in the elimination of them.*

It is evident, that this doctrine will admit of a much more extensive application in pathology, than there is time here to follow out; and I shall confine myself to the illustration of it, in the case of the absorbent vessels. These evidently possess a power of absorbing certain substances, and rejecting others. The lacteals, for instance, in a state of health, take up only the nutritious part of the alimentary mass; for there is in the fecal part, substances equally soluble as the chyle; and this fecal part is actually absorbed, when the lacteals are in a preternatural state, whether from disease or from the action of mercury, as is discoverable by the fetor of the breath. Indeed, the operation of mercury as a medicine, seems to consist in that preternatural absorption excited by it, whereby it removes syphilitic matter and nodes. In like manner, the inner surface of the gall bladder is beset with absorbents, which, however, do not absorb bile in the ordinary state of health, and only concentrate it by taking up the fluid with which it is diluted. But when, in consequence of the obstruction of the gall ducts, the bladder becomes over distended, or when the specific perception of the absorbents is depraved by disease, in these cases the bile is absorbed and thrown into the circulation. At other times, disease consists in affections of these vessels, either by their action being too much retarded, as in the case of dropsy, or where the matter of an ulcer, or that of the pustules of the small pox, is prematurely absorbed, in consequence of the depraved action of fever. It is sufficiently demonstrable, that the whole surface of the skin and *bronchiæ* is beset with inhaling vessels, which absorb the fluids dissolved in the atmosphere; and it would be contrary to the analogy of the rest of the body, to suppose that these are not possessed of some elective power, whereby they prefer or reject such fluids as are presented to them, according to their several qualities, and that this power should not be various, according to the state of health or disease. But, independent of analogy, the variable state of the human body, in respect to its susceptibility of contagious diseases, seems to be a direct proof of this. This has already been illustrated in the preceding Dissertation on Infection.

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* See this subject more fully treated in Elements of Medical Logick.

The specific irritability of muscular fibres, in consequence of the peculiar action of *stimuli*, has been called *perception*, as was mentioned before. This term is not to be taken in a sense strictly literal, but as a metaphor, borrowed from sensation, and applied to motion. In like manner as the senses are fitted to convey peculiar ideas, in consequence of their respective organs being adapted to their corresponding external impressions, so are the various organs of motion by nature made susceptible of excitement from peculiar impressions, either internal or external.

But though there can be no doubt of the reality and necessity of nervous power for the purposes of sensation and volition, it is very questionable how far it is necessary to the involuntary actions, those for example which carry on the circulation. The organs subservient to the latter are certainly supplied with nerves, and the irritability of the heart was supposed to be dependant on the nerves with which it is supplied. This seemed to be confirmed by the action of the heart being suspended by the destruction of the brain, or the division of the nerves leading to these parts; but it has been found by Bichât, and others, that this arose from the nervous power subservient to respiration being interrupted, and that it could act, though its own nerves were divided, provided respiration were maintained.

It is in these points that the chief physiological controversies have arisen. Having elsewhere* endeavoured to prove that the main cause of these contests has been the want of discriminating between those actions of which the nervous system is the *constituent* and *actuating* cause, from those in which it is only *influential* for the purpose of maintaining the connexion or internuntial correspondance, as it were, of one organ and function with another, as is necessary in the more complicated animals, I need not here enlarge on this subject.

The question, however, concerning the existence of irritability, as well as other attributes of life, independant of the nervous system, is an essential part of our subject. Mr. Hunter maintained that in the most simple animals no brain or nerves could be found, and that they are unnecessary; for, these animals possessing no function but that of assimilation, they do not require that variety of action, and that complicated influence necessary for the mutual actions, re-actions, and sympathies of the compound animals of the superior orders. It is well known, not only that the muscular fibres of animals endowed with a nervous system will retain their irritability for some time after their separation from the brain and nerves, but that there have been monsters destitute of brain, and even of spinal marrow. It is not a little in favour of this opinion also, that no nerves are to be found in the placenta.

There are, besides irritability, other attributes essential and peculiar to life evidently independant of the nervous system, as may be exemplified with regard to that conservative principle by which living animal substance counteracts putrefaction, and also, that by which it generates and maintains heat. It is evident, likewise, from the *phænomena* of vegetation, that irritability may exist in nature, without sensation, consciousness, or any suspicion of the existence of a nervous system. The facts I allude to, are not only the perceptible motions of the sensitive plant, but more particularly those motions which must necessarily take place in all plants, in carrying on their growth; for there is no accounting for the accretion of solid parts, in consequence of the conveyance of nutrition by the propulsion of the sap, but by admitting some power, acting by laws different from those of dead matter. How could the matter which composes the wood and foliage of the summit of a tree have arrived there without a vital power counteracting gravitation? Lastly, the state of an egg before incubation, or of a seed under circumstances in which it is not excited to developement, also the condition of those animals which become torpid from cold, and afterwards revive, are in proof of this; as they shew that there is a certain principle of self-preservation, independent not only of the operation of the nervous system, but even of organization and of the circulation; for, in this quiescent state, these portions of organic matter are preserved for a great length of time from that corruption to which they would otherwise be liable, and their fluids are prevented from freezing in a degree of cold, which would congeal them, were they destitute of every principle of life, and in other particulars, form exceptions to the establishment of that equilibrium of temperature which takes place in inanimate matter.

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* Elements of Medical Logick.

But though simple life may be considered as distinct from the nervous system, which is only an accessary appendage to it, yet in those animals in which they are conjoined, the purposes of nature render them dependant on each other. The functions of the brain, for instance, cannot go on without the action of the heart; for whenever the circulation of the blood is interrupted, consciousness and sensation are destroyed, as is evident in the case of a swoon, and in the effects of strangulation. On the other hand, as has been before observed, the action of the heart has a dependance, though indirect, on the influence of the nervous system. There are also incontestable proofs of the extreme vessels being affected by the influence of the brain; for we know that a thought in the mind will produce partial determinations of the circulating fluids, as in the case of blushing, and the fulness of the vessels in the organs of generation and digestion, in consequence of their respective appetites. It does not, however, follow, from all this, that irritability depends on the nerves; the influence of which may be considered as modifying general irritability, in the manner already mentioned; or it may be considered rather as a *stimulus* to the muscular fibres, than as endowing them with irritability, as in the instances last adduced. We have seen that the heart can act independant of the nervous system, and that the vessels of the extremities can exert their usual action independent of it; for there are cases in which the natural heat and circulation continue in the limbs, after a total deprivation both of voluntary motion and sensation. This fact is ascertained, both by the experiment of cutting the crural nerve of a living animal, and by the circumstances attending certain diseases. I lately met with two cases of palsy, in which there was a total loss both of sensation and voluntary motion in the lower extremities, and yet the natural warmth and circulation remained. In one of these cases, excoriations were produced on the feet by sinapisms; and in the other, blisters rose on the knees, but without exciting any sensation, and the parts healed as in a healthy person. The first, was that of a gentleman advanced in life, in whom this affection came on after the gout in the stomach, and he died in consequence of the palsy extending to the bladder and other *viscera*. The other was that of a young woman in St. Thomas's Hospital, who had been subject to violent hysterical convulsions. After a tedious illness, she entirely recovered the use and feeling of her limbs. Mr. Edwards, at Paris, has found that a wound in the extremity of a frog will cicatrise after the head has been cut off,* and Dr. Wilson Philip has found the same after the nerve of the limb has been divided. Even after the natural heat has left a muscle it is excitable by galvanism. This is the state of it so well described by Mr. Hunter in his Treatise on the Blood and Gun-shot Wounds indicated by a state of *tension* and *firmness*, as distinguished from the state of complete death indicated by the *flaccidity* of the fibres.

But there are other circumstances that would seem to prove, that the nervous system is not only a mere appendage to life, but that it tends to impede its operation, and shorten its existence. Simple life will not only survive sensation, but will survive it longer, if the animal is killed, by destroying the nervous system, than if it had been destroyed by hæmorrhage, suffocation, or other violence. It is a curious and well ascertained fact, that if a fish, immediately upon being taken out of the water, be stunned by a violent blow on the head, or by having the head crushed, the irritability and sweetness of the muscles will be preserved much longer, than if it had been allowed to die with the organs of sense entire. This is so well known to fishermen, that they put it in practice, in order to make them longer susceptible of the operation called *crimping*. A salmon is one of the fish least tenacious of life, insomuch, that it will lose all signs of life in less than half an hour after it is taken out of the water, if suffered to die without any further injury; but if, immediately after being caught, it receives a violent blow on the head, the muscles will shew visible irritability for more than twelve hours afterwards.

There is a circumstance observed with regard to animals of warm blood, which seems to depend on the same principle. An excessive exertion of voluntary motion, immediately before death, prevents the muscles from becoming rigid when cold, and renders them more prone to putrefaction. Thus, if an ox be killed immediately after being overdrove, the carcase will not become stiff when it grows cold, nor is it capable of being preserved by means of salt.

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* See Journal of Science, Vol. IV.

In illustration of the same principle, it may be remarked, that there is a symptom in certain diseases of the human species, shewing that digestion, which is one of the principal functions of simple life, will sometimes go on better, in consequence of lesions of the brain ; for in those disorders in which the exercise of the senses is in a great measure destroyed, or suspended, as in the hydrocephalus and apoplectic palsy, it happens not uncommonly that the appetite and digestion are better than in health.

From these facts we may infer, with Mr. Hunter, that the exercise of sensation is inimical to life, and that a sort of fatigue is induced by this, as well as by voluntary motion, in that complex animal machinery in which a nervous system is indispensable, so that all that intercourse carried on through the nerves, whether *towards* the brain, in the case of sensation, or *from* the brain, in acts of volition, tends to wear out the animal powers. And as intense and long continued thought, though not terminating in any outward action, tends also to produce an inability for farther exertions, it would appear that the brain, or sensorium, is more particularly the organ which is subject to that species of sufferance called fatigue. From these facts, we perceive the necessity of sleep, which consists in a temporary suspension of sensation, volition and thought, and is a resource of nature, whereby the powers of life recover themselves after satiety and exertion, which are provided as guards to warn us when nature is in danger of being strained, either by repletion or excess of action ; and it is evident that such barriers were absolutely necessary, in order to set bounds to operations which are only occasionally requisite, and which would otherwise depend on the caprices of the will. The exercise of sensation and voluntary motion, in a moderate degree, is conformable to the intention of nature, and therefore salutary; and it is only when they are excessive, that they tend to wear out the powers of life, and more especially if these are not duly recruited by sleep. Immoderate labor, therefore, and watching, also spasms and convulsions of every kind, are unfriendly to health and long life: in like manner, sensations, when too frequent or intense, especially those which consist in the gratification of the senses, tend to wear out the animal powers; and hence we perceive why a life of sensuality is productive of certain diseases, independent either of the repletion or evacuation which attends them. The gout, but more certainly the palsy, seems to proceed merely from the indulgence of the senses; for the latter commonly enough occurs in the most spare and emaciated constitutions, and in those who have been accustomed to exhausting pleasures, as well as those of a full habit, who have indulged in the excesses of the table. A turgescence of the vessels in the brain will certainly be more apt to produce that rupture of them in which apoplectic palsy consists, when these vessels have been relaxed, as we conceive them to be, by frequent and intense sensations. But in those who are the reverse of being plethoric, and who fall victims to this disease, in consequence of too free indulgence in venereal pleasures, in the decline of life, (as every one who has much observation of the world, or experience in physic, knows to be a frequent case) it must arise from a preternatural weakness in the brain, induced by sensual excitement as much as by animal exhaustion. This accounts for what has been reckoned a difficulty in reasoning on the cause of apoplexy and palsy, to wit, that the same effect should be produced by those gratifications which produce repletion, as by those which produce evacuation. It is observable, however, that these complaints are not uncommon also among the lower orders, in consequence of hard labour and privations.

It follows, from the same principle, that when life is threatened by certain diseases, of which the chief symptom is irritation, any means by which sensation, whether natural or morbid, and muscular motion, whether voluntary or involuntary, convulsive or spasmodic, can be soothed or suspended, will prove salutary, by allowing the powers of life to rally, as it were, and recover themselves. In this consists the operation of narcotic medicines, such as opium, which, in complaints both of a general and local nature, proves useful not merely as a palliative, by the removal of temporary pain or spasm, or by procuring sleep, but as a principal instrument of recovery, by allowing the restorative powers of life to exert their natural action, in consequence of the removal of irritation.

As an example of the general affections of the constitution in which opium is a useful remedy, we may mention those low fevers in which the principal symptoms are tremors, *pervigilium*, and low *delirium*. And as an instance of local affections, in which it has been found highly serviceable, we may mention ill-conditioned ulcers of all kinds, but particularly those which occur in the venereal disease. One of the principal difficulties in the cure of this disease, is that irritability of constitution whereby ulcers are so exasperated, by the use of mercury, as not to bear a sufficient quantity of it to produce a cure. This is obviated by a free use of opium, which seems more efficacious in such cases, than even Peruvian bark, or any other remedy; and this is one of the principal modern improvements in the treatment of this disease.

Having considered the various qualities of the fluids exciting the corresponding irritability of the respective vessels, as a leading principle in carrying on some of the most important functions of the body, and serving to account for many of the vital and involuntary motions, the only other internal *stimuli* that remain to be enumerated, are those connected with consciousness. The great masses of muscle in the trunk and extremities of the body, are the instruments of the mind in acting upon external bodies; and we may, therefore, reckon in the list of *stimuli*, the nervous power by which the will and the passions excite external motions. This is a function sufficiently important for the nerves, without admitting them as the principle upon which irritability depends. This question has been already discussed; but it may be farther observed, that the nervous power being a stimulus acting upon an irritable principle in the muscular fibres, affords a presumption that they are different from each other; for, the matter being considered metaphysically, where any effect is the result of the concurrence of two bodies, as, for instance, in the combinations of chemistry, these two bodies must be different, in order to produce any overt effect. A *tertium quid* necessarily implies two terms of different properties. The motion from the impact of two bodies of the same nature seems an exception to this; but the change produced here is mere communication of the same action, not a new action, such as results from the concurrence of two heterogeneous portions of matter. From the concurrence of a particle of alkali with another particle of alkali, no result follows; nor from the concurrence of a particle of acid with another particle of acid. But let a particle of alkali meet a particle of acid, a result is effected. It is quite otherwise, in the case of mechanical impulse, where the same motion that is lost by one body is acquired by another. But it will not be said, that there is any thing in common, far less identical, in the nature of a nerve and muscle, nor that the act of voluntary contraction is a communication of motion from the one to the other.* It is hoped that this will decide the controversy between Whytt and Haller. The *vis insita* of the latter seems to be the sound opinion on this subject.

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* I derived the ideas contained in this paragraph from a train of thought, into which I was led in an early part of my life, when I addicted myself to metaphysical studies, particularly to a question then

I have already acknowledged my ignorance of the manner in which *stimuli* in general operate, and that this must be admitted as an ultimate fact in nature. But the operation of the will through the nerves, seems involved in double obscurity; for as it depends on the nature of thought, it cannot be made a subject of experimental investigation. For this reason I shall decline the inquiry, as not being adapted to the ends of this Society; and it seems impossible for human sagacity to penetrate the connection of matter with sensation and volition. All such attempts have consisted of abortive and unsatisfactory inferences drawn from hypothetical assumptions. The properties of different bodies, in relation to each other, appear to be the only

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much agitated, regarding the existence of matter; and perhaps the reader will excuse my transcribing here one of the notes which I then made on that subject. "It appears to me that the paradox of Berkeley may be refuted in two ways. First, it may be met by that argument called a *Reductio ad absurdum;* for if any position either leads in its inferences to a contradiction, or is irreconcilable to matter of fact, we are sure it is false, and that some vitious logick must have crept in at some step of the reasoning, though we may not have been able, in any other way to detect it. 2ndly, Let us ask, whence we derive the idea, or if you please, the word EXISTENCE? It may be answered, from our consciousness, and that we can have no certainty of any other existence but self-existence. But no single existence can effect any change or event, and a change or event of some kind there must be in order to create those sensations or states of mind in which consciousness consists. There must, therefore, be something in existence foreign to ourselves, for no change, in other words, nothing which stands in the relation of cause and effect, is conceivable, but what is the result of two existences acting upon each other. Let any one run over in his mind the various incidents that have occurred in the course of his experience, with regard to objects, whether animate or inanimate, and ask himself whether in every change there must not be a congress of two existences. It seems contrary to the nature of things that a solitary existence can be susceptible of a change, without the concurrence of something else."

proper subjects of experimental reasoning; for, in their relation to the mind, they are only the effects, perhaps the remote effects, of their intimate nature upon the senses; and we may venture to affirm that human reason can no more fathom the connection of thought with the corresponding changes in the corporeal organs, than the eye can see itself.

Those affections of the muscular fibres, which depend on the *passions*, though distinct from those excited by the will, may yet be enumerated here among those which flow from consciousness; for there are emotions of the mind that have visible and powerful effects on the heart and vascular system, which are organs entirely out of reach of the will. Not to mention the well known effects of grief, fear, and joy, which affect the whole circulation, there are certain passions and sentiments which produce partial and local effects. These are established by Nature, either to answer some important natural purpose, as in the case of the congestion of the fluids in certain organs, as already adverted to, or to serve as natural expressions, as in the case of blushing and weeping. One of the most striking effects of the passions upon muscular action, is the influence they have upon the strength or mechanical force of the voluntary muscles. Fear produces debility, almost amounting to palsy. Courage and ardor of mind, on the contrary, adds to the natural strength. When the mind is agitated by some interesting object, and calls upon the body for some extraordinary exertion to effect its end, the muscles are thereby enabled, as it were by magic, to perform acts of strength, of which they would be entirely incapable in cold blood. In circumstances of danger, for instance, where life or honour are at stake, exertions are made in overcoming mechanical resistance, which seem incredible, and would be impossible, were not the mind in a sort of phrenzy; and it is truly admirable in the œconomy of nature, that an idea in the mind should thus in a moment augment the powers of motion and inspire additional resources of strength, adequate to the occasional calls of life.* The great increase of strength in maniacs, is also referable to the passions of the mind. These considerations would almost lead us to doubt whether or not the accounts we have of the great feats of strength ascribed to individuals in the heroic ages, are fabulous or not. It is also worthy of remark, that in great and lasting exertions of strength, to which men are impelled by active and generous affections, fatigue is not induced in the same proportion, by many degrees, as by the same quantity of muscular action in the cool and deliberate actions of common life.†

2. The other class of *stimuli* to be enumerated, are the external. These consist in impressions made by outward bodies. They are either immediate, as in the case of those motions which are excited whether by mechanical means, or by acrimony, directly and artificially applied to a muscular fibre; or they are remote, as in the various instances of sympathy, and in the case of those instincts which nature has implanted for the purpose of self-preservation in brutes, and in the early part of human life. I shall here confine myself to a few remarks on instinct, as the other branches of this subject have been fully and ably handled by those who have gone before me in this Lecture.

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* This extraordinary degree of strength, infused into the muscles by ardent passions and affections, has been considered, by unenlightened minds and heated imaginations, as a *supernatural* influence; and the striking effects described above, may form some excuse for superstition in attributing them to the secret agency of some propitious and irresistible power. The etymology of *enthusiasm*, a word expressive of these uncommon exertions, shews that there was originally supposed to be, on certain occasions, some divine influence actuating the human frame. The consciousness of this increased vigor of mind and body, exalted by the belief of its divine source, will serve to account for those peculiar and astonishing efforts of enthusiasm, which are met with in the history of mankind.

† See Observations on the Diseases of Seamen, Book II. chap. III.

There is a connection established between the impression of certain external bodies and the action of certain muscles, analogous to what has already been noticed with regard to the internal motions excited in vessels by the peculiar *stimulus* of their fluids, Nature having instituted certain habitudes between outward *stimuli* and the moving powers, whereby natural propensities are established equally necessary to the support of life as the internal functions. Thus, in a new-born animal, the first contact of the external air excites the act of respiration, and the contact of the nipple excites the act of sucking; both of which actions are absolutely necessary to the maintenance of life, and require the nice co-operation of a great number of muscles, prior to all experience. Actions of this kind are called instinctive, and differ from voluntary motions in this respect, that the latter are the result of memory and experience, whereas the former are the immediate effect of external impressions, in consequence of an established law of nature, and independent of consciousness. The actions of instinct and those of volition, nevertheless, run imperceptibly into each other, so that what was at first instinctive, may afterwards come to be a matter of deliberate choice. The same muscles are the instruments of both, and they differ from the muscles obeying the internal *stimuli*, such as the heart, in this respect, that they are liable to fatigue, and thereby concur with the exercise of sensation and of thought, in rendering sleep necessary. There are no muscles, except those of respiration, of which the constant action is necessary to life, and which are void of consciousness in their ordinary exercise, but which are occasionally under the control of the will. The principal end answered by this power of the will over the muscles of respiration in man, is to form and regulate the voice.

But though instinctive motions are in some cases convertible into those which are voluntary, we should be so far from confounding them, that the former are even compatible with the want of consciousness and sensation; for those animals which are destitute of brain and nerves, are capable of actions analogous to the instinctive. There is something very similar to this even in vegetables, as in the case of tendrils and creeping plants being stimulated, by the contact of other bodies, to cling round them in a particular direction. There are facts, which shew that instinctive actions, even in animals endowed with brain and nerves, do not depend on sensation. I took a live kitten, a few days old, and divided the spinal marrow, by cutting it across at the neck. The hind paws being then irritated by pricking them, and by touching them with a hot wire, the muscles belonging to the posterior extremities were thrown into contraction, so as to produce the motion of shrinking from the injury. The same effects were observed in another kitten, after the head was entirely separated from the body. In repeating this experiment, I found that when the spinal marrow was cut through, between the *lumbar vertebræ* and *os sacrum*, the posterior extremities lost their irritability, but the part below it, the tail, retained it. It might, therefore, be said, that the spinal marrow below the division, served as a sensorium; but it may be answered, that when the head is cut off, its irritability remains, as appears by the motion of the ears, when pricked or touched with a hot wire; and as the extremities are also irritable, it will not be said that consciousness and sensation exist in two separated portions of the same body. Nor can it be admitted that sensibility and consciousness may remain in the head after separation; for, if mere compression of the carotid arteries abolishes sensation and thought, by interrupting the circulation in the brain, how much more must the superior violence of decapitation have this effect? In an acephalous monster, the like *phenomena* were observable. It moved up its knees when the soles of the feet were tickled: it performed the act of suction: passed urine and feces, and swallowed food. It is on record that the same took place in the case of one, in which the spinal marrow, as well as the brain, was wanting. The like takes place with regard to insects; for, after the head of a bee is separated from the body, the hinder part will sting, upon the application of such a *stimulus* as would excite the same action in the animal in a perfect state. These facts shew clearly that instinctive, or rather automatic motions may be exerted, without the intervention of the *sensorium commune*, and therefore, without sensation or consciousness.*

Before quitting this subject, it is of some importance to advert to a curious and interesting connection of voluntary motion and sensation. It is observable that pain excited in any extremity of the body, impairs, for the time, the vigour of the neighbouring muscles, though these have not been the seat of the injury. For example, a smart blow on the shin, will make a person limp, and render him almost incapable of supporting himself on that limb. On the other hand, muscular action brings alleviation to severe pain, as is observable from the writhings and groanings of those under the smart of bodily suffering. If we were disposed to admit loose theories, we should say that the physical cause of these phenomena was the resistance given by the opposite currents of the nervous fluids belonging respectively to volition and sensation, in meeting each other on the route to and from the sensorium, and the extreme parts.

In what I have farther to say on this subject, I shall confine myself to the consideration of two of the most curious and important attributes of life belonging to muscular action, namely, HABIT and IMITATION.

It is the nature of a voluntary muscle to perform any motion with greater ease, the more frequently it is repeated, and to act most readily with those muscles, or in company with those sensations with which it has been used to combine its action, either at once or in succession. This is the foundation of habit, and is the principle by which all the practical attainments of man acquire facility and perfection. It has been mentioned that some actions, originally instinctive, may afterwards be performed as acts of pure volition; so inversely, all actions, which are the result of reason and reflection, may be brought by habit to resemble instinctive actions, and thereby to be performed with greater expedition and effect.

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* See a case by Dr. Yelloly in Medical and Chirurgical Transactions, Vol. III., with reference to other cases in proof of the automatic motions being independant of sensation.

The term Habit has also been applied to sensation; for, as motions are more readily excited by frequent succession, so one perception excites the idea of another, in consequence of repeated connection. In this sense, it ought more properly to be called the association of ideas, a principle upon which Dr. Hartley has built his theory* of the human mind, which, however exceptionable in other respects, is thus far conformable to Nature. It is habit, taken in this sense also, which Mr. Hume† conceives to be the foundation of all our experimental reasoning, inasmuch as it constitutes the only means by which we acquire any intimation of the connection of cause and effect. But though this doctrine is ably and profoundly illustrated by that philosopher, it may be remarked, independantly of other objections, that though these habits are indeed by the constitution of our nature indispensable for acquiring useful and practical habits, they could not have been so unless there had been a corresponding constitution of external nature, without which animals, whether rational or irrational, would have been made susceptible of habit in vain, just as the eye would have been made in vain, had there not existed such a thing as light. Is it not, therefore, a mere abuse of words to say that habit is the sole constituent of all our experience? This constitution of our senses and faculties by which they are rendered correspondent, or parallel as it were to the properties of the external world, consists in that principle whereby nature acts by invariable laws; for it is evident, that if the laws of Nature were variable, those recurrences of perceptions in which habit consists, and on which all experience is built, could not take place; nor could there be any foundation for those principles by which prudence and skill operate upon external objects, for the purposes either of common life or of science. The faculty therefore, by which animals are susceptible of that sort of habit which consists in the association of ideas, may be termed the organ whereby they perceive the uniform succession of cause and effect, established by the invariable course of nature. It was necessary that this should be an instinct, for the sake of self-preservation, not only to mere animals, but to the human species in infancy. If the noxious effects of fire, and the various modes of mechanical violence, such as falls and blows, were only to be learnt by a process of reasoning, all animals would perish before they could attain to maturity. The great difference of man and mere animals in this respect, seems to be, that the latter only perceive these associations, when the objects themselves are present to their senses, whereas the former, by being endowed with memory, can reflect upon them though absent, and thereby render them subservient to experience; for, with regard to external bodies, what is reason but experience; and what is experience, but the remembrance of objects as they affect each other, and the application of this knowledge to the practice of life, in adjusting means to ends, the constituent of what is meant by *Judgment* and *Art?* The principal difference of one man from another, in point of understanding, consists in the readiness with which the mind forms these combinations, and the strength with which it can guard against such as are accidental and fanciful, and discriminate these from such as have an archetype in the nature of things; and that mind, of which the conceptions correspond best with the real associations of nature, is possessed of correct judgment and just observation, the most valuable of all mental attainments. This faculty may be denominated Practical Induction, and all deviations from this sound state of the mind is morbid, and constitutes the various degrees and forms of misconduct, insanity, and delirium.

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* This work has been republished, with a preface, by Dr. Priestley.

† See Essays and Treatises on various Subjects, Vol. III. by David Hume, Esq.

It would lead to disquisitions too long and too intricate, and, in some measure, foreign to this place, to enlarge farther on the various effects of the combination* and succession† of ideas which connect animal with intellectual nature. I shall only remark, that those internal faculties upon which habit and association depend, carry a reference to external nature, exactly analogous to the mutual relation formerly mentioned as subsisting between *stimuli,* whether internal or external, and the moving powers corresponding to them, and between the organs of sense, and the impressions of external bodies which are naturally adapted to them. Muscular motion and sensation have relation to the single properties of matter, as they affect particular fibres and organs, but habit and association are co-relative to that stated connection of cause and effect, established by the general laws of nature. We can thus trace a correspondence between the motions, sensations, and faculties of animals, on one hand, and the properties of matter on the other hand, from the lowest limits of animal and even vegetable nature, into the boundaries of intelligence.

The like accordance with the laws of nature is observable in the structure of animals, as in their motions and functions, as may be exemplified by that reference to the powers of gravitation manifested in the conformation of the limbs and the position of the viscera, as adapted to the natural motions and posture of the body.

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* See Theory of the Moods of Verbs, by Dr. Gregory. Phil. Trans. Edin. 1790.

† See a Treatise on Time, by Dr. Watson, jun. F. R. S. Lond 1785.

It would appear, therefore, that there is a co-ordinance or *pre-established harmony*,* as it were, between the faculties of animals and the laws of external matter, which is the foundation of all the instinctive habits of animals, as well as the rational conduct of man; and it is impossible sufficiently to admire that sublime contrivance by which the frame of animated beings is thus in all points adapted to the constitution of inanimate nature.

The other instinct that remains to be considered, is imitation. This is an action of which some brutes of no great sagacity are capable, and yet it is the foundation of some of the most important attainments of rational beings, particularly speech, which could not otherwise be acquired, and without which the powers of reason would be extremely limited.† Speech seems to be to thought what writing is to speech, or rather what arithmetical or algebraical notation is to common language, whether spoken or written; for without speech the operations of the mind, particularly that of abstraction, would be extremely limited, nor could there be any of those extensive combinations of thought which constitute a chain of reasoning. It would appear from this and from the remark in page 265, that all the operations of the human mind are founded on sensation, habit, memory, and speech.

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* The learned reader need not be told that the author here refers to the peculiar doctrine of Leibnitz, and that he means merely to allude to it figuratively, without approving or adopting it. This celebrated philosopher held that the obedience of muscles to the will, is not to be ascribed to any physical connexion between the mind and body; but that the deity has so pre-ordained it that the actions of the mind and body should proceed by a parallel but independant series of movements, like two distinct machines, which without any mutual agency, are so constructed as to correspond simultaneously in their motions. Here is another theory of muscular motion, but as it is rather theological than philosophical, and being purely hypothetical and fanciful, *pace tanti viri*, it has not been thought worth while formally to advert to it in its proper place.

† See some ingenious observations on this subject in Dr. Campbell's Philosophy of Rhetoric, Book II. chap. vii.

In the early part of human life, imitation seems equally independent of reason and reflection, as in mere animals. It takes place not only without the operation of the will, but in opposition to it; for yawning is an involuntary spasm of the muscles of the jaw, which is frequently excited by a sight of the same action in others; and there is a case recorded in the Philosophical Transactions, by Dr. Garden,* of a man who, in his adult state, and possessed of reason, imitated involuntarily and irresistibly whatever gestures he saw in others. We are to account, on the same principle, for that general similarity of external manner, and of accent, as well as that conformity of principles and sentiments, observable in particular sects, societies, and nations, and which all men insensibly acquire in a greater or less degree.

The only objects of imitation, are gestures and sounds, and by these are also transferred from one individual to another, the emotions of the mind of which they are the natural expressions. The imitation of gestures seems, at first sight, less unaccountable than that of sounds; for it is performed by members which are objects of sight, and would therefore seem more easily transferable to the correspondent parts of another person. Children imitate motions and gestures before they imitate sounds, and when they begin to articulate, they first attempt those letters, in the pronouncing of which the motions of the organs are the object of sight: these are *b*, *p*, and *m*, among the consonants, and the broad *a* among the vowels. But there are other letters and sounds, in forming which, the organs of voice are so hidden and minute, that we can have no knowledge of what parts are put in motion in order to produce sound. But upon farther reflection, there seems little or no difference in this respect; for, independently of anatomy, we know nothing of muscles but by their effects; and there seems no reason why the *ear* being affected by a sound, should not excite a given motion in the muscles of the *larynx* and *fauces*, as well as that a gesture, by having its image impressed on the retina, should excite motions in the legs or arms. Even where imitation, or any other action, is the result of deliberate volition in rational beings, the motion is not performed from a knowledge of their having muscles. They only *will* the effect, without knowing by what means it is performed; for though it may seem obvious that all the motions of an animal are effected by the shortening of the fleshy fibres, this is a fact with which those only are acquainted who have some knowledge of anatomy and physiology, and may be considered as a fundamental and first-rate discovery in the natural history of the living body. This discovery cannot be traced to any particular improver of physiology, but seems to have arisen, like many other discoveries in science and the arts, rather from the gradual evolution of knowledge than the efforts of any individual. It has at all times been observed, that exertions of strength produce a swelling and motion in the fleshy parts of the extremities, and the word denoting a muscle in different languages, is taken from the resemblance of the motions under the skin to those of a little nimble animal, such as a mouse or a lizard. A muscle is called in Greek *μυς*, in Latin *musculus*, or *lacertus*, and that muscle which is so visible near the ham of a quadruped when walking, is, in the common language of some parts of the country, called the *mouse*. It is not ascertained, so far as I know, who first ascribed the motions of animals to the contraction of fleshy fibres. There is no mention made of this in the works of Hippocrates, but it is very clearly stated by Galen; so that the discovery seems to have been made in some intervening period. This property of muscles is so well ascertained in modern times, that wherever we see a muscular substance, we infer synthetically that some corresponding function must belong to it; and we find an irrefragable argument for the circulation of the blood, only from considering the heart as a muscular substance. This subject has not been well understood till modern times, otherwise the circulation would most probably have been discovered sooner; and even since this discovery, we find some physiologists so little acquainted with the nature of muscular power, that they have invented a fanciful theory of the motion of the blood, by a supposed fermentation taking place in the cavity of the heart. We are chiefly indebted to Dr. Glisson, who lived about the middle of the last century, for the first correct ideas of the irritability and contractility of muscular fibres

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* Phil. Trans. Vol. XII. p. 842.

The last remark, or rather query, which I have to make on this subject is, whether mental *sympathies* may not be resolvable into imitation? There are certain emotions of mind which are caught from one individual to another, whose feelings are as it were in unison, producing sometimes the most important, nay the most violent practical effects, in the history of human affairs. Of this, examples may be quoted in the paroxysms of fanatical zeal, bringing about crusades, and other vehement innovations, furious wars and tumults, civil and religious, of which history furnishes abundant examples. It is a principle, however applicable to good as well as evil purposes, and one which poets, orators, painters and actors, know how to avail themselves of, as one of the main engines for giving effect to their art.

> Ut ridentibus arrident, ita flentibus adflent
> Humani vultus. Si vis me flere dolendum est
> Primum ipsi tibi.

THERE still remains to be mentioned, that important property of living muscular fibres, which consists in a perpetual state of tension taking place at all times, in a greater or less degree, independent of any temporary stimulus. When any muscular fibre in a living animal body, whether in a fleshy muscle or a blood vessel, is divided by incision, there is an immediate retraction of the separated parts; and that this is their natural state, is farther proved by the spontaneous motion which takes place in consequence of the relaxation of an antagonist muscle, as when the mouth is drawn to one side, in consequence of *hemiplegia.* A certain degree of this tension is necessary for the performance of the natural motions of the muscles, whether voluntary or involuntary, and the vigour with which the several actions are performed, depends on the fibres possessing a due degree of this constant tone giving scope to motion. In order to maintain this tone, there must every where be a counteracting mechanical power; and we perceive accordingly, that the great muscles are kept on the stretch by the bones, the heart and vessels by the mass of fluids, and the intestines by the *ingesta*, and their natural contents.

The common integuments also have their salutary degree of tension. This is best exemplified in the scrotum, which being a peculiar duplicature of the skin, its tone and laxity is more palpable than in any other portion of the surface of the body. Its loose and pendulous state therefore indicates a general languor, its corrugated and retracted state is expressive of vigour.

When this tension is either excessive or defective, various irregular and morbid actions are produced. The vascular system is more apt to be affected by various degrees of natural tone than any other part of the body; the reason of which may be, that this very relaxation produces a greater capacity of the vascular system, and the relative quantity of the mass of fluids being thereby diminished, the resiliency and energy of the vessels are not supported even by their former degree of distension. I have observed elsewhere,* that it is conceivable that those poisons which extinguish life in a moment, may act by inducing an instantaneous loss of tone in the vascular system. An excess of it may arise either from the too great elasticity of the vessels themselves, with or without an encrease of blood, or from simple plethora. The first is indicated by a hard pulse, and that corresponding state of the fluids which occasions in blood, when drawn from a vein and cold, a contraction of the crassamentum, and a sizy crust. Simple plethora is most apt to arise in constitutions naturally too lax, and which, therefore, do not bear the loss of blood so well as the former.

A defect of tension in the vessels is produced either by disease, by hæmorrhage, or by natural constitution. In diseases, this want of tension is indicated by general debility and depression of spirits, and by a weakness of the pulse. And as irritability and sensibility are very much affected by tension, a want of it in the vessels chiefly constitutes what is called a nervous habit, such as is most commonly met with in the female sex; and there is nothing more apt to induce such a habit than hæmorrhage, which I have known to produce a long train of hysterical symptoms in those who had not formerly been subject to such complaints. The same principle is also well illustrated by the effect of a sudden removal of tension in the intestines. It is not uncommon for persons in a state of great debility to be affected with syncope, and even instantaneous death, in the act of evacuating the bowels. It seems to be from a like cause that a temporary faintness is produced by the opening of an abscess.

There is a particular constitution incident to both sexes, which is commonly connected with corpulency, and has been called by authors the *temperamentum frigidum, phlegmaticum*, and *spongiosum*, and, in common language, a gross and flabby habit. In these there seems to be a deficiency of the natural elasticity of the vessels, and in certain diseases, even of the inflammatory kind, such as the erysipelas, to which they are liable, tonic remedies, such as the Peruvian bark, are found to be the cure, and even in some rare cases of disease of the lungs, chalybeate remedies have been found beneficially admissible. It is observable that corpulence is generally connected with flaccidity, the cause of which probably is that the adipose secretion stagnates in its follicles for want of that compression which a more tense state of the membranes, integuments, and other adjacent parts would give, and by which the absorption of the *adeps* would be promoted. The want of interstitial absorption in dropsy, is referable to a like cause, and to the want of that strong pulsation which belongs to a more vigorous arterial action.

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* Elements of Medical Logick, page 93, where this subject is more fully treated.

There is, perhaps, no circumstance in which one individual differs more from another, than the natural tension of the muscular fibres; and it would be more useful, as well as more conformable to nature, to found a discrimination of temperaments upon this, than on the fanciful theory of humours; for this difference of constitution not only gives occasion to a variety in natural aspect, but valuable inferences may be deduced from it in the pathology and treatment of diseases.

Not only the general excess or defect of tension, but the inequality of it, may be considered as a cause of disease. It seems highly probable that those local affections which depend on the congestion of fluids, are owing to the difference of tension in particular parts, in relation to the whole system. The whole arteries of the body may be considered as one vessel, the capacity of which is equal to the sum total of all the trunks and branches of the arterial system, and as every part must be equally distended by the mass of fluids, it follows that if the strength of the vessels of any one part should not be sufficient to support an equilibrium, they must yield more or less to the elastic pressure of the rest of the system, and produce disease. I believe this is one of the theories of local inflammation, particularly that of the erysipelatous kind.

There is, however, a circumstance of great importance in the animal œconomy, which must tend in some measure to counteract this inequality of tension. When the muscular fibres of any particular part are under a state of more or less tension than the rest of the system, this is communicated by sympathy to every other part of the body. This is particularly observable in the blood vessels and intestines; for a relaxation in any part of these will produce a like affection in every other part of the animal system. This principle of the animal œconomy has been better illustrated by Dr. Cullen than any other physiologist; and he is of opinion, that great part of the effect of blood-letting in taking off the tension of the vascular system, in cases of inflammation, depends on the depletion of the vessels of the part from whence the blood is taken, for the proportion of the quantity drawn to the whole mass is very small; and it may also be urged in favour of this opinion, that the more suddenly the evacuation is made, the more effectual is its operation in removing the inflammatory disposition, for the more quickly the local depletion is made, the less time is allowed for the restoration of the tone by the replacement of the lost fluid.

What has been hitherto said of muscular motion, has had relation to it as a property peculiar to animal matter and animal life. What I have farther to add on this subject, will relate to the muscles merely as mechanical powers. As they constitute the strength of animals, it may be proper to consider the relation of their force to their bulk, and the relation of the bulk and strength of the body to the density and cohesion of its own materials, and to the bulk, density, and cohesion of the external inanimate bodies with which it is conversant.

It has been demonstrated by Galileo,* that in similar unequal bodies of a cylindrical or prismatic shape, such as the limbs of animals nearly are, the ratio of their efforts to break by their own weight, is in the quadruplicate ratio of their lengths, but that the resistance they make to the same force is only in the triplicate ratio of their lengths. It follows from this, that in order to endow the limbs of animals with the same relative force, it is not only necessary that the bones should possess an encreased proportion of thickness, in order to give an adequate increase of what may be called the dead strength, but a similar increase of living strength will be necessary, by a suitable addition of muscular power, in order to keep pace with the increased size of the bones. Now we observe, in fact, that in the large-sized animals, such as the bull and the elephant, the thickness both of their bones and muscles bears a greater proportion to the length of their limbs, than in the smaller animals, and they are therefore of a less elegant form. But Nature has not carried this so far, as to compensate for the disadvantage arising from the increase of size; for the greater animals have not the same proportional strength, in relation to their bulk, that the smaller animals have. It has been computed† that a flea can draw from seventy to eighty times its own weight, whereas a horse cannot with ease draw more than three times his own weight. This disproportion between strength and size is very observable in different individuals of the human species, when compared to each other; for tall men are not muscular, even in the simple proportion of their stature. The difference in the shape and size of different men may be considered as an accidental variety, or *lusus naturæ*, owing, probably, to his artificial mode of life, and for which Nature has therefore made no special provision.

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* Vid. Opere di Galileo. Discorsi e demonstrazione mathematiche.

† Vid. Haller Elementa Physiologiæ. Cap. IX. Sect. II.

We are led, however, from a view of the same mechanical principles, to perceive the wisdom of Nature in assigning certain general limits to the stature of the human body. Had man been made much larger, he would have been unwieldly, and subject to accidents in his motions, in consequence of the *momentum* of the parts increasing in a higher ratio than their power of resistance. It may be answered, that the parts might have been made proportionally more hard and tenacious. But there are other circumstances in the animal œconomy which would have been a bar to this; for had the bones been harder, they would not have been calculated for the common duration of life, the effect of which being to increase their hardness and dryness, they must be endowed originally with a proportional degree of softness and succulence. And with regard to muscles, a degree of hardness, much greater than they naturally possess, would have been incompatible with their contractility. Another inconvenience of the greater stature of man would be, that he would require larger habitations, more food and clothing, while he would have less relative strength to provide for these wants. On the other hand, had man been of a stature much less than what he enjoys by nature, he would not have possessed sufficient power over external objects, to act up to those superior faculties of mind with which he is endowed, and which by his destination he is required to exert. If nature had conferred on man only one half of his actual stature and strength, with the same powers of reason, we may venture to affirm that he would not have carried his dominion over nature to the same extent. As he is now constituted, his force being commensurate with external nature, he has been able, either by force or artifice, to assert his sovereignty over the woods and fields, by mastering the strongest and fiercest wild beasts; he has been able to change the whole face of nature on the surface of the earth, by works of industry, and monuments of art; he has been able to fell trees, to build ships, and to circumnavigate the planet he inhabits. It is rather a triumph of his reason than of his corporeal strength, to say, in the language of a modern poet,* that he can

> "Measure earth, weigh air, and state the tides;"

or, according to the sublime idea of an ancient philosopher,† that he could turn the earth from its orbit, could he find footing on another earth, from whence to exert the powers of mechanism; but such knowledge and such conceptions could never have been attained but by a being of a due degree of bodily strength and stature.

From what has been said, it may safely be inferred, that as the external bodies with which we are conversant possess given degrees of cohesion, bulk, and density, which require corresponding powers to act upon them; so the human body, at its mean stature, is best adapted for producing those changes upon matter, which are necessary for self-preservation, and the various accommodations of life. And an argument may be drawn from hence against the tenets of those speculative philosophers, who hold that the size and strength of man were much greater in remote antiquity than in modern times. It is evident from what has been said, that if the bulk of the human body were much greater than it is, it would be both useless and inconvenient, and would not preserve that harmony with the rest of nature, which is so agreeable to the analogy of her other works.

I SHALL conclude this Lecture with some remarks on the muscles, considered as mechanical powers acting upon levers.

The first remark to be made upon this, is so obvious, that it has hardly escaped the notice of any modern physiologist, and seems at first sight to militate against that wisdom of nature which is so conspicuous in other respects. What I mean is, the great waste of mechanical power which is incurred by the manner in which the muscles are inserted into the bones. This disadvantageous action of muscles is chiefly owing to two circumstances. One of these is their insertion, in almost every instance in which they are connected with bones, into a part which is much nearer the fulcrum than the resistance. Thus the two muscles of the arm, called the *biceps* and *brachiæus internus*, in order to support in the hand a weight of one pound with the fore arm at right angles to the *humerus*, must exert a power equal to ten pounds. The other circumstance giving rise to a waste of power, is the great obliquity with which they are inserted into the bones upon which they are intended to act, so that the greater part of the force is expended in pressing one bone against another at the articulation, and only a small portion of it in making the flections and extensions; so as to produce the desired effect at the extremity.

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* Pope. † Archimedes.

But these disadvantages are compensated by certain conveniences, and if nature has endowed the muscles with sufficient power for the purposes of life, after making allowance for the waste of force, there can be no reason to find fault with her management. One of the principal advantages arising from this distribution of the muscles, is the preservation of the shape of the members; for unless the muscles and tendons had been pretty nearly in the direction of the bones, they must have passed like bow-strings from one bone to another, in making the flexures of the joints.

In estimating the waste of force, in consequence of the mechanical disadvantages before mentioned, we are to distinguish between those actions which consist in pressure, and those which consist in percussion; for as the *momentum* of the latter depends on velocity, it is evident that there is a great advantage from the insertion of the tendon being near the centre of motion, as greater velocity, with less expense of contraction, will be thereby imparted to the extremity. The muscles, for instance, which are attached to the *olecranon*, in performing those actions with the hand which require rubbing, act with a disadvantage, exactly in proportion to the inequality of the distance from their insertion to the joint of the elbow, and that from the same joint to the hand. This is an act of pressure. But in the case of percussion, as in the action of using a hammer, there is an evident advantage resulting from the velocity communicated to the extremity; for in order to have produced the same velocity, with the insertion at a greater distance from the centre of motion, a much greater range of contraction would have been necessary. The saving of contraction, therefore, may be reckoned another principal advantage in the attachment of muscles near to the centre of motion. As this is a point which I think has not been fully and closely investigated in explaining the mechanism of the muscles, I shall conclude with some remarks upon it.

As the muscles of voluntary motion are subject to fatigue, every circumstance that can tend to diminish this, will be favourable to the purposes of nature. Fatigue depends upon the force, frequency, duration, and extent of the contraction of muscular fibres. It is this last which is meant here to be illustrated. If any one will take the trouble of comparing the fatigue of the *biceps* muscle, in bearing a weight in the hand, with the elbow joint bent to a right angle, with that of bearing the same weight for the same length of time, with the joint at an acute angle, he will be sensible how much the degree of fatigue depends on the extent of contraction, and by attending to the relative situation of muscular fibres, it will appear that nature, in distributing the fibres of muscles obliquely, has had it in view not only to increase their number, but to save contraction.

In surveying the actions of all the various muscles, it appears, not only from the co-operation of different muscles, but from the position of the fibres in the same muscle, that there is hardly an action to be met with that can be called direct. In some instances, two muscles, or sets of muscles, are made to co-operate, so that the motion effected by them shall be in the diagonal of their direction. This is the case of the oblique muscles of the abdomen in some of their actions, and the intercostal muscles in all their actions. Sometimes, different portions of the same muscle produce in like manner an intermediate and combined effect, as in the instance of the *cucullaris*, one part of which being attached to the *vertebræ* of the neck, and another to those of the lower part of the back, their joint effect is to draw the *scapula* towards the spine. And in all the long muscles, however simple their origin and insertion may be, there is an internal obliquity of their fibres, in regard to each other, better described by the late Dr. Hunter in his Lectures, than by any former anatomist; for these do not run from end to end, but there are parts of the tendon running into the belly of the muscle, so as to divide it into penniform and rhomboidal portions. This distribution of the fibres takes off from their length; but as it takes place in those cases where the origin and insertion are at a considerable distance, this can be afforded; and this, as well as the waste of power, in consequence of oblique action, is more than compensated by the increased strength, from the fibres being multiplied; for, in consequence of this structure, there is an extent of tendon afforded sufficient for the insertion of a much greater number of fleshy fibres.

This principle in the mechanism of muscular action, is well illustrated by considering the motions of fish. The muscles of most fish consist of regular series of oblique and extremely short fibres, forming those flakes or layers which every one must have observed in their muscular substance. Their motions are more simple and limited than those of land animals, but much more vigorous; for a fish in the sea has to make its way through a medium about eight hundred and fifty times more dense than air, and with more rapidity. Nature, therefore, instead of giving them muscles whose fibres would run straight from one end of their body to the other, has incredibly multiplied their numbers by the wonderful contrivance of distributing them into short and oblique portions. If one were called upon to name instances of the greatest muscular efforts, it is in fish that these are to be found. I have seen the sword of a sword-fish sticking in a plank, which it had penetrated from side to side;* and when it is considered that the animal was then moving through a medium near a thousand times more dense than that through which a bird cleaves its course at different heights of the atmosphere, and that this was performed in the same direction with the ship, what a conception do we form of this display of muscular power!

An advantage the reverse of what has been stated, arises from the oblique direction of the intercostal muscles, the fibres of which are thereby lengthened; for in parts so near each other as the ribs, there would have been a great inconvenience in their passing directly from one to another. Besides, in consequence of their oblique direction, the origin in the superior rib is placed nearer to the centre of motion than the insertion in the inferior rib, the effect of which is, that all the ribs are elevated, whereby the cavity of the thorax is enlarged, which is the view of nature.

But the advantage or rather compensation of obliquity, which I mean particularly here to demonstrate, is, that the same effect is produced with a less proportional decurtation of fibres, than if the same motion had been performed by a direct power. Borelli has estimated geometrically the loss of power from oblique action, but seems to have overlooked this compensation of it, which is not inconsiderable, when we reflect that there is thereby a saving of contraction, and consequently of fatigue. This can be rendered an object of geometrical proof, and I here subjoin a demonstration of it, which I made out, when engaged in the study of anatomy, in the year 1771.*

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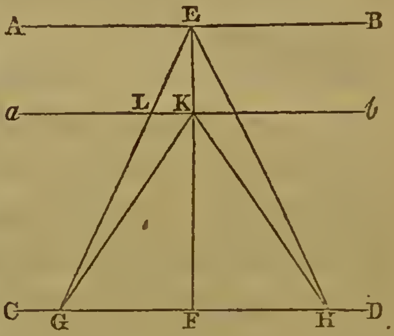
* There is a specimen of this in the British Museum where the weapon of this animal is seen driven through the wood, almost to its basis.

Let the line A B, in the annexed diagram, represent a moveable bone, and the line C D a fixed bone parallel to it. Let F E, perpendicular to these lines, represent a muscle acting in its own direction, and the lines G E H E repressnt two muscles acting obliquely, and producing, by a diagonal action, the same effect as the other. If the bone A B be brought to the situation *a b*, by the action of the muscle F E, the muscle will then be in the situation F K. If the bone is brought into the same situation by the action of the muscles G E, H E, these muscles will then be in the situation G K, H K.



The proposition to be demonstrated is, that the line G K bears a greater proportion to the line G E, than the line F K does to line F E; for F K is to F E as G L is to G E. (Euc. Elem. B. vi. Prop. 2.) and the angle E L K, being less than a right angle, the angle G L K, which is adjacent to it, must be greater than a right angle; and the angle G K L, being in the same triangle with G L K, must be less than a right angle. The line G K, therefore, which subtends the greater angle, is greater than the line G L, subtending the lesser, and therefore bears a greater proportion to G E. But the line G L is to G E, as F K is to F E; and therefore G K bears a greater proportion to G E, than F K does to F E; that is, the fibres of the muscles acting obliquely, suffer a less proportional decurtation than those of the muscle acting directly.

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* This principle was first adverted to by Dr. Mayhew, a physician of great genius of the seventeenth century, and has since been taught in different schools of anatomy, particularly by the late Dr. Monro, and such proofs of it were adduced in a popular way as were sufficiently convincing; but it has no where but here, that I know of, been demonstrated with geometrical rigour,

It is farther obvious, that the more oblique the action becomes, the greater saving there will be of contraction; for in moving the line *a b* towards C D, the line F K diminishes in a swifter ratio than the line G K, and when the former has vanished, the latter is in the situation G F.

I have thus endeavoured to sketch some of the most important particulars in the natural motions of living animals, a subject which affords one of the finest and most fertile fields for contemplating the wisdom with which Nature adapts her means to her ends; and which has been justly considered as carrying the most irresistible evidence of the existence of an intelligent cause. The subject is so far from being exhausted, that I am convinced there are circumstances in the relative distribution and correspondence of organs, depending on muscular motion, so profound and exquisite, as far to exceed the utmost reach of human thought to comprehend, or of human ingenuity to detect; and here, as in every other part of the frame of the universe, the most elevated conceptions which the most enlightened understanding, and most enraptured imagination can form of the beauty and magnificence of Nature, will fall far short of the real sublimity of her works.

DISSERTATION IX.

On the Yellow Fever.

THIS disease, which in its worst form has proved one of the most calamitous epidemics with which mankind has ever been visited, was unknown in the records of physic till the middle of the seventeenth century. It first made its appearance in the Carribean islands in 1647; and in fifty years afterwards on the American continent, at Boston, in New England. The first account of its appearance in Europe, was at Lisbon in 1723. Its chief havock has been in the sugar plantations of the West Indies, and my attention to it as a matter of duty was first called to it from my service in the navy, having been chiefly on that station. It has there raged with little intermission for the last thirty years, with the desolating effect of a pestilence. In North America, its ravages have been equally deplorable, though not so general and unremitting during the same space of time. In particular spots in the south of Europe, chiefly in the seaports of the Mediterranean, it has shewn itself in all its horrors at intervals, from its appearance in Cadiz in 1800, till that at Barcelona in 1821. In the former place it has appeared in all no less than ten times.

There is little wonder, therefore, that this disease should have excited a deep interest in our times in those states which have been affected by it. And though it has never visited the shores of Britain, the immense number of her most valuable subjects who have perished in the West Indies in the service of their country calls forth the keenest feelings of every heart not dead to every sentiment of humanity and patriotism.

This disorder, like all others of a pestilential and malignant nature, sets at defiance the art of physic in its curative capacity; human skill, of which the most anxious and judicious exertions have not been wanting, has been found of little avail in abating the fatality of this epidemic. The great, and only substantial source of hope to be looked to must consist in preventive measures. But from some peculiar circumstances in the nature and character of this disorder, there has most unfortunately been much difference of opinion, whether it is the subject of prevention, for great doubts have arisen in the minds of many whether it is contagious. The vast importance of deciding this question is too obvious to enlarge upon. From my own observation in the islands from the year 1780 to 1783, I had not much opportunity of seeing it in its worst forms. The navy as well as the army, and civil population, were more than ordinarily exempt from it in these years, insomuch, that I saw more cases of what is popularly called the Yellow Fever, which were not of an infectious nature, than of those which were so. I saw enough, however, in the hospital at Barbadoes, and in the ships and hospital at Jamaica, to convince me of its contagious nature in certain circumstances; and from the best consideration I have since been able to give this subject, I remain persuaded that whenever it is so aggravated as to appear in an epidemic and pestilential form it is truly contagious. Under this persuasion, I must further be convinced that the neglect of preventive means cannot fail to be of the most fatal and deplorable consequence, and believing that some myriads of human beings have perished miserably from the contrary opinion, I have felt it my imperious duty to use my most strenuous endeavours to evince what I conceive to be the truth.*

The main sources of the ambiguity in this case have been, 1st, The want of discriminating the remote causes; 2dly, The similarity of some of the most prominent characters which are in common to all the forms of it; 3rdly, The transition of the non-contagious into the contagious form in consequence of foul air and filth in hospitals and ships, or other crowded places, as happens commonly enough in the fevers of Europe; 4thly, Its limited range in point of climate and season, the idea of contagion in some persons minds being that it is essential to its nature that it take place in all circumstances and situations. 5thly, Its not extending itself to the rural population, those only being susceptible who live in towns, or other dense and crowded communities.

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* The greater part of this Dissertation will be found in the first edition of Medical Logick. Lond. 1819. The same subject is noticed, but slightly, in the second edition; for, I was then under the

All these will be duly adverted to in the course of this Dissertation.

In order to avoid the first source of fallacy, it is necessary to remind the reader, that there are three sorts of remote causes which give occasion to fevers, in whatever climates they may arise. One class of these causes is the exhalations of the soil, producing intermittent, and remittent fevers, which occasionally pass into continued fevers, particularly when under the influence of other remote causes.

The second class of occasional causes, is vitiated human *effluvia*, generated by the living body under circumstances of crowding, filth, want of ventilation, and change of apparel, aggravated occasionally by scanty and unwholesome food, as exemplified in the jail, hospital, and ship fever, and that of the indigent part of the population: and all pestilential epidemics seem to have had a similar origin, diversified according to circumstances not always definable and ascertainable. In the pestilential distempers, recorded by historians and poets, which broke out in besieged towns and besieging armies, famine appears to have been a main ele-

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belief that the opinion of non-contagion had been nearly eradicated, but finding this not to be the case, I have deemed it my indispensable duty to repeat my utmost efforts in asserting the cause of truth and humanity.

ment in their production. That described by Thucydides, at Athens, was quite different in its characteristic symptoms from the modern plague of the Levant. The pestilential disease called the Sweating Sickness, so fatal in England from 1486 to 1551, was still more different from it. It was engendered by the wretched state of the army brought to England by Henry the Seventh, previously to the battle of Bosworth. There are interspersed, in the records of physick, the histories of many other peculiar infections, some of them local, extremely limited, and transient.* Infectious fevers, therefore, arise, prevail, and become extinct, under circumstances endlessly varied according to the indefinite combinations of the pre-disposition of the subjects acted upon by the different degrees and kinds of impure air, bodily and mental hardship, and privations. On this part of the subject also, the reader is referred to the Dissertation on Infection in a preceding part of this volume.

The third class consists of that disturbance of the system, occasioned by fatigue, insolation, intemperance, the privation of food, and sleep, sudden alternations of heat, and cold, acting either jointly, or singly, in creating fever.

Of these three, the second only is found to be contagious.

They are all three found to exist in the West Indies, (by which is meant the Islands called the great and small Antilles, or Carribean and Mexican Archipelago, and the adjacent coast of America) in common with other countries.

But in conformity to what has been said regarding the irregularity of the *phenomena* of infection, there are found to be peculiar and unaccountable circumstances regarding it on this station, for the fevers originating from these three remote causes are all accompained with a yellow colour of the skin, which being a conspicuous symptom, has procured for them all the appellation of yellow fever, giving occasion to great confusion, and serious mistakes. This colour of the skin is not quite unknown in fevers in other parts of the world, even in cool or temperate climates. I have met with it in London, both in my hospital and private practice, several instances of it have occurred in the typhous fever which lately prevailed in Edinburgh. Dr. Cleghorn met with a few examples of it in the endemic of Minorca; Sir James Macgrigor mentions that a few cases of it occurred at St. Andero. It appeared in a solitary ship in Gibraltar bay, in 1795.* But it is only in the West Indies that it is met with as a general and characteristic symptom of the endemic and epidemic fevers of the country. In this sense it is unknown any where else, even in other intertropical regions. There is no such symptoms in the bad fevers of the East Indies. Dr. James Lind † has given one of the best accounts of that which prevailed at Calcutta in 1762, and this makes no part of its description. Dr. Johnson, in the history of an epidemic fever in Batavia, says, that the yellow colour of the skin occurred in the course of the disease, in a great number of cases, but this does not amount to a general diagnostic, as in the Antilles. It would be only matter of idle speculation and conjecture, to attempt to decide whether this peculiarity in the Antilles, is owing to some singular properties in the soil and air, or, what is more probable, to some casual concurrence of circumstances brought about by the peculiar state of these islands, such as has been remarked in the Dissertation on Infection at page 211 of this volume. It is conceivable that this peculiarity might have occurred from some assemblage of circumstances connected with the importation or treatment of the African slaves. This is matter of conjecture, but it is matter of certainty that this fever cannot be traced further back than the middle of the seventeenth century, and that no such malady had existed till then in any age or any quarter of the world.

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* See Dissertation on Infection, in the preceding part of this volume

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* This fact is taken from the Journal of the Surgeon.

† This is not Dr. James Lind, of Haslar Hospital, but a physician of equal learning and ingenuity, who passed the latter part of his life at Windsor, where he was most highly respected.

Another remarkable circumstance, with regard to the origin of the West India fevers, is, that they sometimes are found to arise from the foul vapour of ships replete with filth, from long neglect of cleanliness. And it is remarkable, that the fevers arising from this cause, are found sometimes to be contagious, and sometimes not, according to the intensity and nature of the effluvia, and the susceptibility of the subjects exposed to it. It seems to be a general rule, that no effluvia, emanating from corrupted dead matter, even in a state of the rankest putrefaction, ever produces a fever of a contagious nature. It is presumable, therefore, when these exhalations do produce contagious fevers, or convert a common fever into one of an infectious and malignant character, that they consist, in part at least, of the vitiated effluvia, generated by the living human body, constituting some form of the typhous morbific poison.

In order to give that precision to language, which is necessary on every subject, and with a view to avoid misconception, and wrangling, these three classes of fevers shall be designated as follows; the first shall, in the course of this discussion, be called the ENDEMIC; the second, the PESTILENTIAL,* or MALIGNANT EPIDEMIC, or TYPHUS ICTERODES, as it is very properly termed by some systematic writers;† the third, shall be called the SPORADIC. A strict attention to this distinction will, it is hoped, go far towards clearing up the ambiguity and removing the dangerous errors with which this controversy is fraught.

All the three are in vague and vulgar language, styled the yellow fever, and the utmost confusion has arisen in treating of them, as must ever be the case, when one author, or disputant means one thing, and the other a different thing. It has accordingly been from want of precision, in naming and classing these fevers, that contests highly unbecoming a liberal profession, and what is infinitely more unfortunate, errors of the most fatal practical tendency have been engendered by this confusion, and ambiguity of terms.

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* By pestilential, it is here meant only to express a very high rate of mortality, and in this respect the epidemic in question takes the precedence of the plague; for, on a population of 16,000 civil and military, at Gibraltar, the mortality in 1804 was 6000; a proportion considerably above the usual devastation of the pestilence of the Levant.

† Sauvages and Cullen.

This fallacy has in no instance been more glaring, than in some articles which have lately found admission into a respectable periodical publication.* The fever there described, is, by the author's own account, and avowal, evidently of the endemic kind, and in strenuously maintaining that this is not contagious, he is fighting a phantom of his own creation; for no rational advocate of contagion, has ever alleged that a fever of this kind is contagious. The shallow and perverted reasoning of this and some other authors, would not have claimed notice, but as what they give to the world may prove mischievous, by some inexperienced or weak practitioner, applying what is advanced by them, to the pestilential epidemic fever, it becomes the peculiar duty of one, who has been forty years in the medical service of the State, to counteract the baneful impression it may make; and as no example more apt could be selected to illustrate the necessity of verbal precision and discrimination in medical reasoning.

The fevers proceeding from long confined human effluvia, seldom originate in the West Indies; for the heat of the atmosphere is such, that it is not necessary to exclude the fresh air, as in Europe, and other temperate climates. Such fevers, therefore, have become epidemic there, only in consequence of infection occasionally generated and imported by ships under peculiar circumstances of crowding, and filth, exasperated by the length of the voyage, and various hardships affecting the minds and bodies of the crews, and passengers. Examples of these casual incidents are to be found in the history of the different maritime powers, who have planted colonies in this part of the world. Among the English, the most remarkable and well attested are that of a fever which arose in Barbadoes in 1647, as recorded by Captain Ligon, in which he says, that the mortality was so great, that the living could hardly bury the dead. He ascribes the origin of it to certain ships, which had just arrived from long voyages. The same epidemic broke out in the same Island in the year 1695, as related in Hughes's History of Barbadoes; at which time, the former had been so far forgotten, that it was called *The New Distemper;* a proof at the same time that this, like the other, was totally different from the common endemic and sporadic fevers. But the most remarkable of all the epidemics of this kind, which affected the West Indies, was that which arose in 1793, first noticed in the Island of Grenada, in the month of March, a season, at which the endemic, and sporadic fevers, are the least prevalent; and favoured by the peculiar circumstance of the French revolutionary war which broke out that year, it spread rapidly to the British, French, and Danish colonies, attacking them not *simultaneously*, as it would have done had it been the endemic, but *successively*, and therefore contagiously. It was also in every case traceable to intercourse with the infected. In the September of that year it reached Philadelphia, where it had been unknown since the year 1762. In the following year it visited Charlestown, in South Carolina, and in the subsequent year, 1795, New York, in all of which cities, it was attended with the calamities of a pestilence. It has since that period, at various intervals, visited all the maritime towns in the United States of America, from Georgia to New England.

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* See Medico-Chirurgical Transactions for 1818, vol. ix. part 1.

I should have remarked, that this fever was believed on good grounds to have been brought to Grenada in a ship from the coast of Africa under peculiar circumstances of distress,* from which it spread to the ships at anchor around her, destroying in a short time two-fifths of their crew. It then passed to the inhabitants on the adjoining part of the shore, spreading by steps, which could be clearly traced from the original infection in the ship.

In the year 1800, it made its way to the shores of Europe, and exhibited all its tragical effects at Cadiz, imported by a corvette named the Dauphin : also in a slight degree next year, but returned in 1804, with even greater violence than in 1800. Its next appearance here, was in 1813, and again in 1815. It broke out at Malaga in 1803, and in

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* The first and principal publication on this subject, is by Dr. Chisholme; who, like the inhabitants of Barbadoes in 1695, believed it to be a new disease, and calls it a *nova pestis.* This argued a want of knowledge of its history, but it argues at the same time that this belief could not proceed from *prejudice* or *prepossession,* but from the honest conviction of his mind, forced upon him by the irresistible evidence of the facts under his eye, to him new and singular. Dr. Chisholme seems also to betray a want of knowledge of the history of infection, in his great anxiety to prove that a malignant fever must previously have prevailed in this ship. It is well known, that typhous infection will accumulate to the most intense degree, without affecting those by whom it has been generated; and that it is on strangers that it exerts its virulent properties. All the medical practitioners of that island had the like convictions; only one disbelieved in it, and he but for a short time; and it is no small proof of its contagious nature, that six practitioners of medicine died of it, a mortality far greater than that of any other class of men. Dr. Stewart, a practitioner of nineteen years standing, and to whose excellent judgment, and long previous experience of the climate, the utmost deference is due, has on various occasions publicly attested his firm belief, that this epidemic was a disease quite distinct from any that had ever before come under his observation. Dr. Gilpin, physician to the army, bears the same personal testimony as Dr. Stewart. The latter informed me verbally, that he pronounced the disease to be distinctly different from the common endemic, before he heard of the ship from Africa, or any suspicion of its being imported in her, being then in the interior of the Island.

1804 at Gibraltar, where it also made its appearance slightly, in the year 1810 and 1813, but was checked in its progress by vigilant measures of police.

It next spread, at various intervals, to Carthagena and Alicant, and in 1804, to Leghorn, lat. 43, which was probably the most northerly place to which it could, by its nature, reach; and it was here experienced in a very slight degree, thanks to the vigilance of Dr. Palloni, who opposed it as soon as the yellow skin and black vomit betrayed its nature. The most remarkable instance of its appearance in Europe of late years, has been at Barcelona, where it broke out soon after the arrival of some ships from the Havana, in June and July 1821. The yellow fever prevailed there at the departure of the ships, and more than twenty persons died of it on board of some of them, on the passage. The magistrates of Barcelona, at its first appearance, began to take measures of precaution for preventing its spreading, but being resisted by the inhabitants, abetted by certain physicians, who treated the opinion of contagion with ridicule, these measures were suspended. The consequence was, that in no place have its ravages been more horrible than in this city, and its environs. More than twenty thousand fell victims to it in the city alone, in the course of four months; no part of the population being spared except those in prisons and the paupers in some charitable institutions, where rigid seclusion took place.* A committee of Spanish physicians was appointed to consider and report on this subject. The great majority were in favour of the opinion of contagion. Four physicians were sent from France on the same service. One of them caught the fever, and died of it previous to the report, in which the three survivors were unanimous in favour of the existence of contagion. The conclusion of it, as drawn up by one of them, Dr. Pariset, is transcribed in the note.* This epidemic made its appearance at this time in several parts of the Mediterranean, but in none of them in which it could not be traced to the Havana infection. Among other places it broke out at Marseilles, but was promptly extinguished by efficient measures of police.

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* See Rapport sur l'origine, &c. de la fièvre jaune, translated from the Spanish, Paris, 1822. This committee consisted of members of the National Academy of Practical Medicine regularly ap-

In tracing it farther back, we find that its first introduction into Europe was at Lisbon in 1723, probably brought from Brazil, and it has never since appeared there. It next appeared at Cadiz in 1732, three years after its first appearance in their colonies. It returned in 1733, again in 1744 and 1746, and 1764, and not again till 1800; nor was it known in all that space of time, in any other part of Europe, except once at Malaga, in 1741. These dates are taken from Baron Humboldt, on whose accuracy and fidelity, perfect reliance may be placed.

To return to the West Indies: among the French, the most remarkable instance of this epidemic, is that recorded by Père Labat, of its introduction to Martinique in 1686, by a ship called the Oriflamme, under peculiarly calamitous circumstances, from Siam, whence it got the name of *Maladie de Siam;* and *fièvre de Matelôt.* And Père du Tertre, who

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pointed by the Government.—It is necessary to warn the reader against another report made by a self-constituted tribunal, at the head of which was the Author of an English work, the object of which was to disprove the contagion of plague. The facts so incontestably proved by the legitimate committee regarding the fever at the Havana, and on board of the ships on their passage, are here not only questioned, but flatly contradicted.

* "Yes, the disease that now devastates Barcelona is truly the yellow fever of America.—Yes, it has been imported.—Yes, I repeat it a thousand times, it is contagious. Let it be hoped that the facts which we have accumulated will enable us to master the partisans of the contrary system.—Yes, this fever is a hundred times more pernicious to commerce than the most rigorous quarantine could possibly be. With only five days good police, and firmness, both Barcelona and its commerce might, humanly speaking, have been

wrote a history of the French colonies, in the end of the same century, calls it *La peste jusqu'alors inconnue dans les isles.* It was severely epidemic at Cap François in 1742.

In the Spanish West Indies, it is mentioned by the historians of that nation,* that it was unknown in those colonies till the year 1729, when it appeared at Carthagena, in Terra Firma; and that it broke out in Guayaquil, in Peru, in 1740. With regard to the Portuguese, it is distinctly described by Ferrayo de Rosa, a physician of Olinda, in Brazil, where it prevailed in 1687, immediately after the conquest of Pernambuco, and broke out on the arrival of the ship Oriflamme, already mentioned, on her passage from Siam to Martinique.

In North America, the first mention of it is at Boston, in 1693, where it was believed to be brought by the fleet from the West Indies, under Admiral Wheeler; he came from Martinique, so that the infection was probably derived from what was imported in the fleet from Siam a few years before.

The next mention of it on that continent was at Philadelphia, in 1695, and at Charlestown the same year.

We next hear of it at New York, in 1702. There is no detailed history of it, but being designated by the appella-

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preserved, even on the avowal of the anti-contagionists of this country. But what has been the fact? They wrangled, they disputed; the scourge entered, raged, proved fatal, and nobody knew how to remedy it. Hence all labour, all industry, all prosperity is here extinct for a long time. The heart itself has partaken of this depravity. The father shuns the presence of his children, and there is an adieu to every feeling of humanity. Oh that the administration had been unceasingly vigilant, and did not tamper in this amalgamation of follies and iniquities.!"

* See a Voyage to South America to measure a degree of the Meridian, by Don George Juan, and Don Antonio D'Ulloa. The same very respectable historians and philosophers say that those who have once had it are not liable to it a second time, vol. i. p. 46. English Translation, Lond. 1758.

tion of the *Great Sickness*, and described as resembling the plague in fatality, it can be no other than our pestilential epidemic imported by commercial intercourse with the West Indies.

The first medical description of it is by Dr. Mitchell, of Virginia, in 1744, who imputes it to contagious effluvia.

The next professional account of it is by Dr. Lining, of Charlestown, in South Carolina, written in 1748, but comprising the description of this epidemic as it appeared there in the years 1732, 1739, 1745, and 1748. Till the first of these years, it had never been known in this colony. He says, it was undeniably infectious; and that in every one of these years, the introduction of it could be traced to persons arriving from the West Indies. (See Physical and Literary Essays of Edinb. Vol. II.) There is no account of it that I know at Philadelphia in the last century, till 1751, when the infection was introduced in a trunk of clothes, belonging to a person who died of it in Barbadoes.* It spread only to the family and a few of the neighbours, and no more than two hundred persons died of it. But it was not pestilentially epidemic till 1762, and did not re-appear there till 1793, as before mentioned.

There are two questions at issue with regard to this epidemic. 1st. Whether it has been occasionally engendered on board of ships, and carried to the sea-port towns of the West Indies, and from thence spread, by contagion, to North America, and Europe: or, whether it is only a different degree and form of the endemic, and sporadic fevers, which at all times prevail more or less in these countries? The other question is, whether it is infectious? In the agitation of this controversy, these questions have in general been regarded as involved in one issue; importation being considered as implying contagion. But on this subject, a schism has arisen among the non-contagionists; for Dr.

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* See the works of Dr. James Lind, of Haslar Hospital.

Bancroft had allowed, in his Essay on the Yellow Fever, 1811, and still more explicitly in the sequel to that work, 1817, that this diease might be excited by exhalations from the ballast, and stores of ships, while he denied that it could be conveyed on men's persons, or that when excited by these exhalations, it could become contagious. He adduces, in proof of this, the fact, that the fever in the cases in question, near New York, did not extend beyond those who had connexion with the ships, overlooking however a passage in the narrative, stating, on an authority which he will not question, that of Dr. Edward Miller, the great champion of non-contagion, that the whole inhabitants fled from the spot, " by which (he says not very consistently) it was suddenly arrested." It may here be remarked, that the unsophisticated good sense of the inhabitants of the countries in which this epidemic has prevailed, taught by direful experience, every where fly from it with instinctive horror.

Dr. Miller, and others of the party of non-contagionists, will not however concede to Dr. Bancroft, that the fever can originate in any form, from a foreign source, continuing sturdily to maintain its exclusive domestic origin. To this there are two exceptions, Drs. Lidyard, and Lord,* both of whom publicly renounced their long entertained opinion of its endemic nature, and yielded to the irresistible evidence of its foreign origin. We have not learned whether they became converts to contagion, as well as to foreign origin, but the first mentioned of these candid and ingenuous gentlemen, has since unfortunately fallen a victim to the disorder.

But this is not the only point, in which importation, and non-contagion, have been disjoined, for Baron Humboldt, while he throws great doubts on importation, founding his opinion on the writings of Rush, and others to whom he refers, expresses his firm belief in the contagious nature of the Andalusian epidemic, founding it on the very able report of the three commissioners appointed by the French Government to investigate it, and who describe it as spreading from house to house, by contiguity, as a fire does; and he states it as fully ascertained, that those families who shut themselves up in the midst of it in Cadiz, escaped it.

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* See American Med. Phil. Regr. vol. I. page 484, and vol. I. page 299.

It has been objected by the other party, that those commissioners were not on the spot when the epidemic prevailed. If this objection were well founded, it would go to invalidate all judicial investigations whatever. It is not deemed a necessary qualification for a judge on the bench that he should have been actually present at the transactions upon which he is to decide. On the contrary; by an accurate and comprehensive survey of the points and bearings of a complex case, he is better qualified to form an opinion, than the actual actors in them, besides being divested of prejudice. It is on this principle that a court of justice is the only fit place for investigating matters of fact. It is requisite, for the forming of a clear, calm, and impartial judgment, that objects, whether natural or moral, should be placed at a certain distance, in order that they may be seen comprehensively in all their relative positions and bearings, which the eye and mind of a close observer, or of a party concerned, is incapable of taking in and duly appreciating.

There was the same proof of the existence of contagion at Gibraltar in 1804, as at Cadiz, for the Spanish Consul, Colonel Fyers of the Engineers, and others, disregarding medical opinion, saved themselves and their families by seclusion.

In considering this subject on the general principles of abstract reason, it seems much more presumable, that the malady in question should originate from a fortuitous cause, than from the common course of nature. Is it conceivable, that a disease, totally different from any till then known, in the memory of man, by tradition, or history, should, in the course of seventy years, as at Cadiz, make its appearance six times, at unequal intervals, and in no other spot in Europe, except once at Malaga, unless from a foreign cause? and it is remarkable, that the degree of prevalence in those parts of the old world was in exact proportion to the degree of intercourse with the new world, and with each other; for the ships from the Spanish colonies hardly frequent any European port but that of Cadiz;* and the intercourse of this city with Malaga, Carthagena, Alicant and Leghorn,† and of these with each other, is more frequent, and constant, than with any others. Nor has this epidemic ever made its appearance either in rural districts, nor in any inland or uncommercial towns, such as Rome, Naples, Palermo, and others lying in the susceptible latitudes. Nor has it appeared in Turkey or Africa, though in the same latitudes, except in one instance in the latter, in that part which is adjacent to Spain. Again, is it conceivable, that during the hundred years, that Gibraltar had been in possession of the English, that is from the year 1704, when this fortress was taken by the army under the command of the Prince of Hesse, to the year 1804, in which this pestilential epidemic fever for the first time broke out, this disease should never once have shewed itself, if it depended on causes at all times existing, and present? When it is gravely affirmed by a medical authority, that this singular, and till then unheard of epidemic, could here proceed only from the exhalations of the soil, and when the circumstances of this arid rock are taken into account, the author appeals to his reader, whether a proposition more extravagant, more repugnant to reason, more irreconcilable to history, and analogy, ever fell from the mouth or pen of any man? Is it not inconsistent with every conception of an endemic disorder, and contrary to observation, and experience, that it should thus be unknown for so long a series of years? and considering this abstractedly, is it not repugnant to the first principles of reason, that a casual effect should proceed from a constant cause? The same may be said of Cadiz, the whole surface of which is either rock or sand; and while these pestilential epidemics raged in Cadiz and Gibraltar, the districts around, which are really marshy, were entirely free from it.

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* Since this was first written, it has appeared here several times in a mitigated degree, so as to make the number of its visitations to this city to amount to ten. Till the late revolutionary irregularities, all ships from Spanish America, except a few belonging to the Caraccas Company, which were permitted to go to a port in the bay of Biscay, were compelled to use Cadiz as their port Is it possible that any one can believe that such a great comparative frequency of it at this spot had no connexion with its American intercourse?

† A most accurate and satisfactory account of this endemic has been given by the learned and judicious Palloni of Leghorn, demonstrative of its imported and contagious nature.

The like reasoning will apply to the occurrence of this fever in the West Indies, and North America; and when it is farther taken into account, as an additional element of computation in the doctrine of chances, that these new and singular events, thus combined in each of these tracts of the globe, widely disjoined indeed, but in a state of constant intercourse, fell out *successively* in all of them in the course of one and the same series of years; it is quite inconceivable on principles of calculation, as well as by the laws of nature, that these events should happen by fortuitous co-incidence, and without the least relation to each other, as cause and effect.

Under an abstract view of the question, it is also presumable, and nearly demonstrable *a priori*, that unless the yellow fever, vulgarly and loosely so called, had been in some circumstances contagious, in others not, so much ambiguity and diversity of opinion could not have arisen. No such controversy has arisen regarding the intermittent fevers of the fens of Lincolnshire, and the marshes of Zealand, which are universally admitted to be endemic, and non-contagious; nor do they vary greatly at any intervals of time; but that they should take on a pestilential form at the season of the year least liable to them, as was the case with the malignant fever of Grenada, would be out of all bounds of probability. And if the fever in question were in all circumstances equally non-contagious, could any doubts of its contagious nature ever have arisen?

Having discussed the presumptive proofs in favour of the foreign origin, and contagious nature of this epidemic, on abstract principles, let us take a review of the matters of fact which can be adduced on the same side of the question.

1st, It has never shewn itself in the first instance but in a sea-port town, and never in the interior of the country, whether island or continent.

2dly, It has, in most cases, been ascertained, that it has made its appearance in that sea-port, after the arrival of one or more ships,* either under those peculiar circumstances which engender infection, or conveying the infection from ports where it had already existed. Most of the great epidemics of the West Indies, North America, or Europe, can be traced to one or other of these sources. If it cannot in every instance be traced, this may happen from the want of historical facts: neither does it follow that infection does not exist, though it cannot be traced, for nothing is so subtle as infectious *effluvia*. It is well known, that small-pox and measles find their way where there is no possibility of tracing the source of the infectious matter; but will any one deny the existence of small-pox, or measles, in a family, because the source of them cannot be traced?

3rdly, No part of the population of the towns where it has broken out, has been affected, but such as had communication with shipping, directly or indirectly. A striking example of this has happened at New York since the first publication of this Dissertation. In consequence of a negligent administration of the quarantine in September 1819, some sailors belonging to ships from Baltimore, New Orleans, and the Havana, at all which places the malignant fever then prevailed, were permitted to land at one particular wharf. The fever broke out at that spot and spread to the immediate vicinity; but having been arrested by vigilant measures of police, the rest of the city was saved from the impending calamity.*

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* See this exemplified at Barbadoes and Grenada, page 291; at Martinique, page 294; at Brazil, page 295.

The authorities for this opinion, besides the strong ones already quoted, of Dr. Mitchell and Dr. Lining, are the testimonies and writings of Sir James Macgrigor, Sir James Fellowes, Mr. Pym, Sir Joseph Gilpin, Dr. Stewart of Grenada, Dr. Gordon of St. Croix, Dr. Arejula of Madrid, the French commissioners already mentioned, also those sent to Barcelona in 1821, and many other equally candid, competent, and honourable men, who had the best opportunities of closely investigating the subject

The doubts have been maintained more plausibly in the West Indies than in the temperate climates, on account of the resemblance of this epidemic to the endemic, and sporadic fevers of those colonies; but the testimonies of Mr. Pym,† Sir Joseph Gilpin, Don George Juan, and Don Antonio D'Ulloa, and others, go directly to the point, and cannot be invalidated without impeaching the moral character of these honourable men; a species of argument, however, which it is to be deplored, has not in every instance been abstained from by the partisans of this question.

With regard to North America, evidence the most overpowering on this subject is to be met with in the American Medical and Philosophical Register, in four volumes, published at New York, in the year 1814. There are in this work such a multitude of clearly ascertained facts in proof of its foreign origin, and contagious nature, that there is not room here for the bare recital of them.

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* This is on the authority of a letter from Professor Hosack, of New York.

† See a very concise, plain, and satisfactory account of this matter, in an article in the 5th vol. of the Med. Chirurgical Transactions, by Sir Joseph Gilpin, who had the advantage of seeing this epidemic in Grenada and Martinique, as well as Gibraltar. But the work of Mr. Pym is the most full and convincing; and the most insuperable objections to non-contagion will also be found in that of Sir J. Fellowes.

My own humble efforts have not been wanting in the same cause. In the year 1798, I wrote a letter to Mr. Rufus King, Minister from the States of America to the British Court; and in the year 1805, another to Baron Jacobi, Minister from Prussia, for the information of their respective governments. In these letters, I laid particular stress on what occurred regarding a French ship taken in battle on the coast of America, in May 1795, on board of which this fever, or its infection, was found, and was communicated to the seamen of the British ship Hussar, by the men in health, who were shifted into her from the prize. It is evident that if it could be proved that this fever is communicable from one ship to another at sea, such a proof of the reality of contagion would be of the nature of an *experimentum crucis*, there being no possibility of land exhalations to account for it. Such I then considered, and still consider the facts of this case to be. They were, however, so strongly and speciously contested by Dr. Bancroft, as greatly to frustrate the impressive effect which my statement was calculated to produce. The reader will be able to judge of the solidity of his objections, from an annotation at the end of this work. I feel to myself that I was so far from making too much advantage of these facts, that I might and ought to have availed myself of them still more. I might have adduced them as a very striking illustration of the incompatibility of this disease with a certain temperate degree of atmospheric heat; for the change into cool and pure air, in proceeding to Halifax, did, in a very short time, first deprive it of its malignity, and then of its infectious nature, so as entirely to extinguish it. The few that were seized, after arriving at Halifax, might have imbibed the poison in the warmer latitudes through which they passed. It was on the strength of such facts as these, that, in my conferences with the members of the British Government, and in my correspondence with those of Russia and Prussia, I ventured to assure them, that in none of those countries was there any thing to fear from the importation of this pestilential epidemic, which in the end of last century, and the beginning of this, had so afflicted the West Indies, North America, and Spain, as to excite a general alarm throughout Europe. My anxiety to establish this, and the very extraordinary means resorted to by the advocates of non-contagion to invalidate it, will be readily understood, when the great and decisive importance of it is duly weighed. For if there is any such thing as a law of evidence, or if there is any infallible criterion of truth to be found, it is undeniable and incontestible, that if it can be proved, even in a single instance, that this disease has been communicated from one ship to another *at sea*, the controversy is at an end. Let those, then, who maintain the opposite opinion, either come forward and invalidate this fact, or give up the point, on the issue of which the decision of the question depends. I challenge any one to point out the smallest ambiguity in it; and if there were any shadow of doubt, there are other parallel cases equally cogent and well attested to furnish a redundance of evidence; for there have occurred, since the period alluded to, other cases besides this of the Hussar, equally conclusive, regarding the communication of this disease, from one ship to another at sea. It will be enough to specify two, in one of which the proof is even stronger. A French ship of war, the Palinurus, lying at Martinique, severely affected with the yellow fever, was ordered on a cruise to try the effect of sea air on the disorder. She fell in with and captured the Carnation, a

British sloop of war on her passage from England, part of the crew of which were seized with the fever while at sea.* Another French ship of war, in which this fever prevailed both at St. Domingo, and on the passage to Brest, made prize of a merchant ship from the Mediterranean, off Cape Finisterre, and having, without shifting the prisoners, sent a party of their own seamen to navigate her, the crew of the prize caught the fever, and almost all died of it.† The men belonging to the prize having been seized on board of their own ship, makes this a stronger case than those in which the prisoners were carried on board of the capturing ships, for in the latter case it might have been said, that the infection was derived from the exhalations of the hold or stores, whereas, in the former, it could only be from personal contagion.

There is still another useful remark, which I did wrong in omitting in my statement. Of fourteen men sent from the Hussar to navigate the prize, nine died before reaching Halifax, a passage of twelve days; the other five were sent to the hospital, where some of them probably died. Now, though it is mortifying to reflect that medical means should not have more control over this disease, this statement seems to afford the consolation of reflecting, that these means are better than none at all; for an opportunity here offered, which but rarely occurs, of ascertaining what are the results of the spontaneous tendency of unassisted nature. There was a mortality of nine in fourteen, and those who were sent on shore, not having had the benefit of medical attendance, at that stage of the disorder at which remedies are most availing, did probably not all survive. This is a rate of mortality far exceeding that of the most unsuccessful practice, even that of Hippocrates.

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* See Dictionnaire des Sciences Médicales.

† See Traité de la Fièvre Jaune, par Louis Caillot, Dr. en Médecine, Paris, 1815, p. 202.

4thly, The effect of quarantine regulations and vigilant police in shutting it out, and repelling its first assault, and the equally effectual and salutary result, of shutting up in the midst of infection. All these good effects have been experienced at Gibraltar, and elsewhere. It has already been mentioned how it was arrested there, *in limine*, in the years 1810 and 1813, and that many families were preserved in the midst of the desolating epidemic of 1804, by cutting off all communication with the garrison and inhabitants. The effect of seclusion at Cadiz, has already been mentioned. The persons in the jail, hospital, and poorhouses of Philadelphia, remained exempt from the pestilential epidemic in its utmost rage, all external intercourse having been prohibited. The same was observed of prisoners of war at Jamaica; and last year, 1821, the same is attested to have happened at Barcelona.* The American Register abounds with innumerable and irrefragable proofs of the good effects of seclusion and quarantine; and they ascribe to the more vigilant execution of the regulations of the latter, the exemption from it at New York since 1805, at which time, as well as in 1803, they make no doubt, that it had insinuated itself in consequence of the loose measures of the quarantine, which, by a singular and unaccountable infatuation of the American Government, had been put under the directions of professional persons, who avowed their disbelief in importation and contagion. It may also be remarked here, that during the whole of the American war, from 1775 to 1782 inclusive, no epidemic occurred, an immunity which they ascribe to the intercourse with the West Indies having been suspended.

It has been admitted by one party of the non-contagionists, as already mentioned, that this fever may be imported by ships having foul ballast, or tainted stores. Dr.

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* See Rapport sur l'Origine, &c.

Bancroft, one of those who admits this, has been at great pains in another part of his work, to shew that no accumulation of filth, however great, and however putrid and corrupt, can produce febrile diseases on shore. It would have been satisfactory, if he had specified in what peculiarity the exception of the holds of ships was founded. I have the good fortune to agree with him, both in thinking that febrile miasmata do not in any case consist in the exhalations of simple putrefaction, and that fever may be produced by the exhalations from the holds of ships. But I am at no loss in specifying in what the corrupted exhalation of the latter, differ from the former, namely, in their involving morbid secretions, particularly the sordes of the skin, and tainted *effluvia* of the living human body. These may long lie latent, and harmless, both to the crew and passengers, who become habituated to them on long voyages; but immediately affect visitors, on the arrival in port, particularly when the foul materials come to be stirred, as I saw strikingly exemplified in the French prizes at Jamaica. (See Diseases of Seamen, 3d Edit. page 88 et seq.) It forms no objection, therefore, to the importation of a fever being referred to a particular ship, that the fever did not actually exist on board of her at her arrival.

It becomes a curious and interesting, though painful question, what are the grounds upon which this deplorable and mischievous delusion is founded, for every error must originate and rest upon some false and mistaken principles, and these must have been of a nature uncommonly plausible and seductive, to have won so many partisans of respetable talents, and unquestionable good intentions. Of these the following seem to be the chief.

1st, The great similarity of this pestilential epidemic, to the endemic, and sporadic fevers of the Antilles. The most conspicuous point of resemblance, is the yellow colour of the skin. The resemblance, however, is not perfect here;

for the colour of the former is a dingy orange, in the other two a bright yellow.*

There is another symptom, in which all the three species bear a resemblance to each other; the vomiting of a coffee coloured liquid in the dangerous, and almost hopeless stage. This symptom, however, is by far more frequent in the pestilential epidemic than in the other two. It was so striking and constant in the former, that the Spaniards gave it the name of *Vomito Prieto*, dark coloured vomit, when it made its first appearance among them, which was at Carthagena in 1729, as already mentioned, and it has retained that name ever since, though sometimes called Fiebre Amarilla. The College of Physicians of Philadelphia, besides mentioning the dusky colour as distinguishing it from the endemic, states, that it differs from it also in having no intermissions in the first days. According to the description of Dr. Chisholme, and others, the epidemic is distinguished also by violent pains in the head and legs, a piercing pain in the eyes, generally in one eye, more aggravated sensorial affection, such as coma and delirium, and above all by a greater malignity, that is, a much higher rate of mortality and resistance to remedies than in the other two species. The characters of this fever, as distinguished from the ordinary fever of the climate, are depicted in lively colours by the surgeon of the Eurus frigate, in his journal, examined officially by me in 1797. In a few days after the arrival of this ship at Grenada, eighty men were rendered unfit for duty, that is, about a third part of the crew: the eyes swam, as it were, in blood, with excruciating pain chiefly in one eye: the eye-ball started in one: in seven cases, one of the eye-balls was absorbed: in the course of convalescence, some lost their sight, though they retained the substance of their eye. Who will say that this differs in nothing from the endemic and sporadic fever of the Carribbean Islands? though it may in many other cases have been so moderate as not to be distinguishible from that of sporadic or endemic origin; just as many cases of the true plague were not distinguishable from continued fevers. One of its further and most material distinctions is, that few of those who have had the true typhus icterodes, or pestilential epidemic, are liable to it a second time. This must be understood under the qualification applicable to all diseases of this kind. Small-pox and measles admit of the fewest exceptions, scarlet fever more;* vaccination as a security against small-pox, still more. The principal Spanish author, Dr. Arejula†, adduces incontrovertible facts in proof of those being safe from a second attack who have once had it. The same fact is equally well attested by Sir Joseph Gilpin, Sir James Fellowes, and Mr. Pym, under their own eyes, so that there does not seem to be the possibility of a fallacy. It is established by all the laws of evidence: by the multitude of cases, and the concurring testimony of persons who had no concert with each other, and no motive but that of truth. It is evident that no such inference could be drawn from a few cases, but the induction is founded on the cases of thousands, and the fact was so well established, that the Spanish Government made a proclamation, requiring those who had passed through the fever in the former epidemic, not to quit Cadiz, but to lend their assistance to the sick; and both Spanish and English selected their nurses from among those who had had it. Time and experience had so firmly established this confidence, that when this epidemic shewed itself here in autumn 1819, those who had previously passed through it, were under no fear or alarm, and were not anxious either to quit the city nor to have recourse to seclusion with a view to avoid it.

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* I have elsewhere, (See Diseases of Seamen, page 411) started a doubt, whether the yellow colour was owing to bile, but rather to some *error loci*, or depraved state of the red globules. 1st, This colour does not appear first in the eyes, as in jaundice. 2nd, Sir Isaac Newton observes, that the blood reduced to thin *laminæ*, assumes a yellow colour. See Optics. B. i. P. 2. Prop. 10. 3rd, The like colour appears in *ecchymosis*, some time after a contusion. The yellowness of the yellow fever sometimes does not come on till after death. It seems deducible from these facts, that this colour may be owing to the red globules getting into the colourless order of vessels, in an attenuated, or vitiated state, and not to absorbed and circulating bile.

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* Transactions of a Society for the Improvement of Medical and Chirurgical Knowledge, vol. iii. page 445. London, 1800.

† See his work entitled Brieve Descripcion de la Fiebre amarilla, Madrid, 1806, page 229. This is a work of extraordinary merit, bearing the characters of great industry, accuracy, and sound reasoning.

Those who deny contagion, adduce strong facts in favour of the opposite side; but they are evidently taken from the endemic cases, or are mere exceptions. And there cannot be a stronger proof than this, of the reality of the difference of the two disorders, so that these facts may be said to militate in favour of contagion.

I have not experience of my own, to decide on the various points of difference, for the four campaigns in which I served in the West Indies were in years comprehended in one of those intervals before alluded to, between the appearance of these great epidemics. The mortality was indeed comparatively very moderate there, during the whole of that war, chiefly owing, no doubt, to there not having been great bodies of land forces transported thither, during that time, the war having been almost entirely a maritime one, and from no ship specifically infected, having arrived at any of the ports on the station. Some mixture of it with the endemic and sporadic, did occur both at Barbadoes and Jamaica; but, from want of predisposed subjects, it did not spread. There were clear cases of it at the hospital of Barbadoes, evidently produced by overcrowding, as so frequently happens in the typhus of Europe, and the much greater mortality of medical officers at Jamaica in 1782, gave strong presumption of its existence there. My recollection of the above mentioned occurrence at Barbadoes is the more fresh, from the remarkable circumstance of a young negress employed as a nurse, having been seized with the most unequivocal symptoms of this fever, though it had been affirmed that neither females nor negroes of either sex were liable to it. There are other proofs equally satisfactory of the endemic fever degenerating into the contagious, in an article of great merit by Mr. M'Cabe, Surgeon of the York Rangers in Trinidad, in the year 1817, inserted in the Edinburgh Medical Journal. In a letter also from Mr. Laing, an army surgeon in the same island, inserted in the 2d vol. of Dr. Trotter's Medicina Nautica, the transition of the endemic yellow fever to the malignant is clearly evinced.

But admitting the symptoms to be ever so similar, it does not follow that they are *identical.* A great proportion of the cases of the true plague, were without the *tokens* or diagnostic characters, and some could not be distinguished from a continued fever, as already remarked; but in spite of this close resemblance, plague and fevers are essentially different in their nature. Great inconvenience arose here also from their being externally undistinguishable; for we find that in the history of plagues, both in England and France, particularly at Marseilles, there were sharp professional contests between the contagionists and non-contagionists, the latter, pertinaciously denying the existence of it, and sometimes so far influencing the public authorities, that precautions were so long deferred as to allow the malady to get beyond the reach of prophylactic means. Will it be said, because there are ophthalmias resembling the infectious ophthalmia, there is therefore no such thing as infectious ophthalmia? Has it not also occurred to every practitioner in this country, to see sporadic fevers, when there was not the least reason to suspect contagion, so far resemble the typhous fever from infection, as to be undistinguishable? Those cases of Erysipelas,* which arise from infection, do not differ in appearance from those which arise spontaneously, but are very different both in their nature and treatment. If it can be proved that the malignant epidemic has a different origin, and greater fatality, to be of a contagious nature, and never, or very rarely, capable of being caught a second time; these are sufficient diagnostics, let the outward symptoms be ever so similar.

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* See Transactions of a Society for the improvement of Meaical and Chirurgical Knowledge, vol. xxii. page 213.

2dly, The doubts, respecting the conveyance of this infection from the West Indies to North America and Europe, and the consequent doubt of its identity, may have proceeded from the fever in these temperate climates, being more extensive and fatal in its ravages, than in the country from which it is alleged to have been derived. Though it was severely afflicting in the Antilles, it did not attack so great a proportion of the population by far, as in Philadelphia, New York, Cadiz and Gibraltar. A very little reflection will clear up this difficulty. In the West Indies, the susceptible subjects are chiefly the new-come white people from Europe, for a very small proportion of the seasoned white inhabitants, and a still smaller of the creoles and negroes, are affected by it. But in North America and Spain, the whole population is in the same predicament, with regard to predisposition, as the white new-comers in the West Indies, who constitute a very trifling proportion of the whole population.

3dly, They allege, that an infection which vanishes of itself on the approach of winter, in North America, and even of the mild winter of Andalusia, and which does not spread among the adjoining rural population, is either no infection at all, or does not deserve that name; that the name of infection can only be applicable to such a disease as the small-pox, which makes no distinction of climates and seasons. But in the first place, we can see no reason for believing that all infections are governed by the same laws.* Variety, is as characteristic a feature of nature as uniformity, particularly in all that relates to organic beings and animal life. Mere analogy can only be held as presumptive evidence, and may serve as a fair ground for rational conjecture and suggestion, but must ever stand subordinate to facts and observation, and may widely mislead us if too much confided in. It is little better than gratuitous assumption therefore, to say, that every infection must conform itself to that of small-pox, and the history of other infections militates against such an assumption. Would it not therefore, be more conformable to reason and sound philosophy, to reconsider, and recast theories, in order to make them quadrate with facts, than to strain, suppress, and deny facts, and question the veracity of honourable men, because they cannot be brought to conform to the theory? But if analogy were to decide the question, a strong and obvious analogy might be alleged in favor of this infection being controlled by circumstances of time and place, taken from the history of the true plague. This latter epidemic has never been known either in the tropical or arctic regions, from what cause it is not known. I profess myself unable even to guess whether difference of temperature acts upon the poison, by exhaling or decomposing it, or on the living powers of the body, by rendering it unsusceptible of its action. It would be still more difficult to assign a cause for one range of heat being necessary for the existence of plague, and another for the existence of the typhous icterodes. These are matters of pure observation, and so far from being founded upon or suggested by theory, as some anti-contagionists have affected to allege, they baffle all theory; and I can say for myself, that so far from having

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* See a judicious arrangement of the varieties of contagion by Professor Hosack, of New York in the American Medical and Philosophical

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Register, vol. ii. page 14. Also an article in the Transactions of a Society for the Improvement of Medical and Chirurgical Knowledge, vol. iii. page 441.—The Author has endeavoured in Dissertation VII. in this work, to bring together all the known distinctive and comparative characters of various infections, on which to found a classification of them.

any theory, I am incapable of forming any hypothesis or conjecture on the subject.

But the knowledge of this is by no means necessary. It is the fact only, which is wanted for the present purpose. And it is incontrovertibly established, by the experience of ages, that the existence of plague cannot co-exist with a heat of the atmosphere, above 80°, nor a little below 60°. It never fails to disappear in Egypt, at the summer solstice,* the heat being then pretty uniformly at 80°, or upwards. Its chief prevalence therefore, is in Lower Egypt. It is almost unknown in Upper Egypt; not at all in Abyssinia, nor at Mecca, and the southern parts of Arabia. On the other hand, it appears from the history of all the plagues, of which there is any account in England, that they have never begun to appear, epidemically, but in the end of June, or beginning of July; that they proceed increasing till September, when they are at their *acme*, and then decline till they entirely subside in winter, with the exception of a few sporadic cases.

The pestilential yellow-fever in like manner, has its own range of atmospheric temperature, but on a higher scale than the plague; for it cannot subsist long, if the thermometer falls below 80°. It has never been known in North America, nor in the South of Europe, but at the season of the year in which tropical heats, that is of 80°, or upwards, prevail; and it has never failed to disappear in winter, even in the mild winter of Spain, as already remarked. Nor has it ever appeared in those parts of Europe, where the summer heats do not rise to the tropical pitch. It has never been known in France,† nor England, and but once in Portugal. Its range has been circumscribed to Cadiz, in latitude 36°

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* The same is mentioned by Bacon, as happening in Barbary. Historia Naturalis, Cent. iv.

† Caillot mentions that it once merely made its appearance at Brest, and died away. The latitude is 48. 23.

25′, the south coast of Spain, as far as Leghorn in Italy, in latitude 43° 33′, the most northerly point which it has reached as an epidemic.

4thly, It has been farther argued, by the non-contagionists, that, if it were really contagious, it would spread from the sea-port towns to the adjacent country, which it did not, either at Grenada, or in North America.* If it can be made good, as a matter of fact, that it is actually infectious in these towns, this argument can be of no avail; and it will be for those who delight in speculation, to exercise their ingenuity in accounting for its not extending to the country, by inventing some theory that will tally with the fact. But here too, we are not without the countenance of analogy, for something very like this happens in the plague. This great epidemic has a wonderful attraction to dense population, and squalid habits of life. It is this, together with the neglect of precautionary means, which at all times fosters, and perpetuates it in the Mahommedan towns; and in London, it always fell first on the indigent, and ill-aired quarters of the town. The Lord Chancellor Clarendon,† relates in the history of his own life, that when he quitted London, with the court, in the plague of 1665, and returned next year, he missed very few of his friends and acquaintances, who remained behind, the ravage having, in a great degree, been confined to the lowest orders of the people, who, in that age, lived in circumstances of great filth, and foul air. This fact is mentioned in still stronger terms in the account of the plague which prevailed at Copenhagen in the year 1711. It states that scarce one person of note died of it.‡ I am induced to suspect, and even to believe, that the exemption of London from plague ever since 1665, has been owing to the improved habits of life, which began on occasion of the great fire, the year after the plague, and have rapidly gained ground ever since. The commerce, and general intercourse with the Levant, as well as all other parts of the world, has been so much greater than in former ages, that it is difficult to believe, that particles of infection have not at various times been imported, but they have failed to take effect, for want of a suitable *nidus*, or fuel, as it were, to foster and kindle them.

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* It was observed at Barcelona, as well as in North America, that this infection did not spread among the rural population, with the exception of three persons, as stated in the Barcelona Report, p. 43.

† See Medical and Chirurgical Transactions, vol. iv. p. 102.

‡ See Dr. Short's General History of the Air, vol. ii. p. 5. Lond. 1749.

5thly, They still farther allege, that it is contrary to the common course of nature, that a disease, without any adequate or assignable cause, should thus visit these islands, at such long and uncertain intervals. This objection is much more applicable to that opinion which imputes this disease to the exhalations of the soil, which being an act of Nature, ought to be much more steady than that which depends on the contingency of human events. But waving this, the like argument will apply to the visitation of hurricanes; for, it is beyond the reach of human sagacity, to say, why these islands should be more liable to them than any other portion of the globe; or why they should return at such uncertain and unequal intervals: far less can our philosophy detect upon what modifications of the atmosphere these convulsions of it depend. But shall we therefore deny the reality of hurricanes? This pestilential fever is the hurricane of the human frame, equally uncertain in its recurrence, equally dark and inscrutable in its cause, equally and deplorably certain as to the reality of its existence; but unequal as to its powers of destruction, if this is to be measured by the loss of human lives, for it has caused a greater waste of the species, than all the convulsions of nature put together, hurricanes, earthquakes, and inundations. Is it to be endured, that, by a piece of cavilling sophistry like this, a monster shall be unchained, which, in the course of a few years, has devoured more than half a million of human victims?

Lastly, The advocates of non-contagion seem to have been much influenced by the spirit of simplification or generalisation. This appeal to the uniformity of Nature, is answered by the frequent reference we have made to the great difference between animated and inanimate Nature, as subjects of analogy, the latter being from its variety and complexity infinitely more liable to diversities and exceptions. It is on this principle that they have laid great stress on definition, holding that the term infection is not applicable but to those diseases which possess a contagious property in all circumstances of climate and seasons, of purity and impurity of air. To these the only answer must be, "Be it so; but are you, in order to indulge yourself in this miserable play of words, to sport with the lives of thousands of your fellow-creatures?" This definition excludes the plague, and it will hardly be believed, that, in this age, there are persons pretending to medical education and science, who actually argue that this disease is not contagious. I am told there is a work of two quarto volumes recently published, the chief object of which is to maintain this extraordinary doctrine: and a work has lately been published at Strasburg, the object of which is to disprove the contagious nature of the venereal disease. No rational reader will expect the Author to enter into a serious refutation of such disgusting and extravagant paradoxes. We are compelled to apply to physicians, what one of the ancients has said of philosophers, *Nemo ægrotus quicquid somniat tam nefandum quod non aliquis dicat philosophus;* but with this material difference, that the conceits and absurdities of philosophers, are generally harmless; whereas those of physicians may draw along with them the most serious and fatal calamities. This definition excludes the yellow fever, as well as the plague; and here that sophistry which is founded on ambiguity of language has opened another source of fallacy; for, they maintain also, that the term yellow fever can mean only one single disease. But ought the experience and common sense of mankind to surrender themselves, to any profusion of bewildering words, however confidently and imposingly pronounced, and spread through some thousands of pages? What can be so affecting and humiliating, as that persons of the plainest understandings should form sounder judgments on these important points, than those who value themselves on scientific attainments and research? Will not the world, without judging with its usual severity, be disposed to regard these our boasted attainments and researches, not as the legitimate lights which guide us in the avenues to truth, but as false lights, leading *us* into error, and *them* into danger; and tauntingly pronounce of our learned labours, that they only teach us *insanire ratione modoque.* Nor can it be matter of indifference to those, who feel for the interest and dignity of the profession, that any of us should become objects of disrespect, and be exposed to the sneers of the extra-professional part of the community, by falling into errors, which lie open to the detection of the most ordinary and uncultivated minds.

But, according to the strict principle upon which this question ought to be decided, all these reasonings are absolutely nugatory, and only a waste of time; for, if it can be historically made out by legitimate evidence, as a matter of fact, that this disease in its epidemic form has never taken its rise but in sea-port towns, where it can, in most cases, be traced to the arrival of shipping conveying infection; that it has never spread, but by contact, or near approach to the sick, and if it can be excluded by quarantine and separation from the sick, then do all discussions become vain regarding the resemblance of its symptoms to other diseases, or the previous state of the ship which imported it, or its communication being limited to a given temperature of the air, or to a given susceptibility of subjects; and whether it is conveyed in the holds of ships, or on men's persons, and whether there is a marsh or no marsh in the vicinity. All these points are quite foreign to the subject, the simple question being, whether the disease is actually communicable from one person to another. It is only the matter of fact, as established by evidence, with which those civil and military authorities have to do, to whom is entrusted the sacred charge of the public health. These authorities perceiving the jarring opinions of medical men, may, without deference or reference to them, undertake to judge for themselves, on a point to which any man of good sense and understanding is competent, as it hangs upon matters to be decided by the rules of evidence, not involving professional knowledge, the only matter of doubt being this essential property of the disease, its being personally communicable. And in case these authorities should wish for assessors to sit in judgment with them, they will probably deem it more safe and advisable, to ask the assistance of some members of the bench or the bar, accustomed to weigh evidence, and investigate facts, or even of such plain men as compose juries, than of medical men, having so much reason to suspect, that our minds are warped by prejudice, with our heads so overcharged with learning as to leave no room for common sense; and so over-heated with contention, that we are more intent on victory than solicitous about truth.

Every one acquainted with human nature, knows how difficult it is for the mind to extricate itself from the shackles of prejudice, when rivetted not only by time, and habit, but by that pride of opinion, which confirms, and perpetuates self-delusion, in opposition to the clearest evidence- But it is the duty of every liberal and considerate man to observe forbearance, and to judge with indulgence of weaknesses from which none of us are exempt. Gentlemen, whom I know to be men not only of the greatest integrity, and honour, but of superior attainments, have advocated the cause of non-contagion, *bonâ fide*, and with intentions as pure as those of the opposite opinion. Nor is it easily conceivable, that any set of men, far less those of the medical profession, can be otherwise than sincere, or that they can mean positive mischief. If there have been persons who have stooped to the suppression of facts, and even to connive at perjury, as has been alleged, I should not impute even this conduct to bad intentions, but to that misguided and erroneous conscience, which by a perverted casuistry, deems pious frauds to be justifiable, and holds that a *little evil* may fairly be done, in order that a *great good* may come of it. All this ought to serve as a warning to the junior members of the profession against embarking hastily as the partisans of any doctrine, particularly such as involves some of the dearest interests of society, for in the course of time, they may be called upon to engage in a struggle, in which no man ought to be confident of his powers, namely, that severe ordeal of human virtue, by which they may be required to sacrifice the pride of opinion at the shrine of conscience by an abjuration of error.

It may be alleged by the partisans of the other side that, to those who advocate the cause of contagion, the imputation of a blind adherence to inveterate prejudice is equally applicable. The fairness of this is not denied. Let the candid, impartial, and judicious arbiter of this question, whether among cotemporaries or posterity, judge betwixt us. Only let two important points distinguishing the two sides, be taken into consideration before the award shall be pronounced. The one is that the advocates of contagion have on their side the great advantage of *Moderation;* for they concede that a great proportion of what is called yellow fever is free from contagion; whereas the other party, or a great majority of them, will not admit even of a doubt regarding the truth of their opinion in all cases. The arbiters will no doubt consider on which side Catholic bigotry and infallibility are most conspicuous.—The other consideration is, that if there be the shadow of a doubt in any practical case, the safe side for the judges will be that of contagion; for, whatever temporary loss or embarrassment may arise to commerce, or whatever inconveniences may be imposed on individuals, by personal restraint, these evils weigh as nothing in the balance against those of a spreading pestilence.

It is obvious, from what has appeared in the course of this discussion, that an accurate and ample history of a disease is requisite, for the purpose of prevention, as well as for that of cure. The errors we have been adverting to have arisen, in the first instance, from the want of a sufficiently comprehensive knowledge of the subject. It was viewed on a local, partial, and narrow scale, instead of being surveyed in its whole extent, and various bearings. Accordingly, we see, that as knowledge has accumulated, error has vanished. In America, during the last years of the last century, the majority of opinions were in favour of non-contagion, and even public medical bodies gave their opinion on this side; but in the year 1805, the College of Physicians of Philadelphia, as a body, gave their opinion in favour of contagion, asserting that the evidence of this was as strong, as for that of the plague; and almost every member of that of New York, has publicly given the same opinion: such is the meliorating and maturing influence of time! The College of Physicians of London have given their verdict on the same side. *Commenta delet dies.* But such zeal has of late been exerted, and not without success, still to prop the opposite opinions, as to induce the Author to dwell upon the subject thus fully, earnestly, and repeatedly.

The question seems now to be brought to such a point, that we may venture to challenge any candid, intelligent, and unbiassed man, whether in or out of the profession, and whose mind is not indelibly imbued with the dogmas of non-contagion, to open his eyes, and deny that this disease is contagious; and if it be not, then has the Author of this discussion lost every faculty of distinguishing truth from falsehood, of discerning light from darkness.

P. S. Since this work was put to press, the Author has met with a letter from Dr. Pariset, to Dr. Robert, of Marseilles, dated Montalegre, near Barcelona, the 27th of November, 1821. After expression of deep regret at the neglect of preventive means, and after adverting to the conversion of many of the advocates and abettors of the opinion of non-contagion, this eloquent, animated, and philanthropic physician concludes his letter as follows: "Their own acts confound them: the cry of so many victims overwhelms them: they are ashamed to live on the grave into which they have precipitated so many unfortunate beings. One moment of sincerity, one slight sacrifice of self-love, a shade of distrust in themselves, would have saved Catalonia a load of evils, and themselves from endless opprobrium and remorse. They hope to escape from opinion: but opinion overtakes and judges them, and even the vulgar who applauded them, now condemn them."

NOTE

REFERRED TO AT PAGE 303.

On the 16th of May, 1795, the Thetis and Hussar British frigates, cruizing off the Capes of Virginia, fell in with five French armed ships, and after a severe action of an hour and a half, three of these struck their colours: but from the disabled state of the frigates, only two could be taken possession of. They proved to be the Prevoyante and Raison. The latter had been employed at Guadaloupe as a prison ship, a situation of all others the most likely to engender and harbour a stock of infectious filth. It was found, on boarding this ship, that there had been great sickness and mortality among the crew from the yellow fever since she sailed, which was on the 25th of April. Great care was taken in shifting the prisoners on board of the Hussar, to remove only those in perfect health. It was found, that notwithstanding this precaution, the same fever began soon to spread among the crew of the frigate. On the 28th of May, the frigates and their prizes arrived at Halifax, but only a few of the sick were landed, for the inhabitants taking alarm, lest the infection should be introduced into the town, it was determined, after a consultation of naval officers, that the remainder of the sick should be landed at some miles distance from the town, and accommodated in tents, and that the ships themselves should be put in quarantine. The like precautions were taken with regard to the sick prisoners. The number of sick landed from the Hussar, under the care of the surgeon of the ship, and his assistant, was eighty-three, all of whom recovered. The calamity which befel the men sent to man the prize, has been stated in the former part of this work, page 305.

The truth of this statement was denied by Dr. Bancroft, in a work published in 1811. His arguments are grounded on discoveries which he alleged he had made in documents deposited in the public offices in London. He perceived in the muster books at the Navy Office, that the whole of the prisoners' names were entered as victualled on board of the Hussar, to the number of 116; and that prize-head-money had been paid for the same number. From this he inferred that the whole of the French crew had been brought on board of the frigate; that there was not only no yellow fever, but no illness whatever among them, either on board of their own ship or in the frigate, for he understood that no men could be victualled but what were actually on board, and that all sick men were checked for their provisions; concluding from all this, that the whole story of the yellow fever was a fable, invented by the surgeon of the Hussar.

Having myself served for four years as physician to the largest fleet that ever was employed on foreign service;* and, having in that time been present in six general actions, these statements and assertions, so contrary to what I understood to be the rules of the service, greatly astonished and startled me. But lest my recollection should have failed me, or lest there should have been some change in the regulations, I addressed a letter to the Chairman of the Victualling Office, who having been a naval officer himself, was well acquainted with the practical rules, as well as the official business of the service. I also sent Dr. Bancroft's book to the office, begging them to make a report on that part of it which related to this subject. The Report is in the following words:

"Prisoners of war of every description, whether wounded, "sick, or well; whether remaining on board of their own "ships, or transferred to the capturing ship, are entered

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* See the second Dissertation in this volume.

"on the books of the capturing ship, for two thirds allow-"ance of provisions. There is no exception to this, unless "when a prize is taken so near an English port as to be "brought in, the same day. It seldom happens that all the "prisoners are shifted; not only the sick and wounded, but "generally some of those in health being left on board to "assist in working the prize, in consequence of the few "men ships of war like to part with on these occasions. If "the prisoners should fall sick, they would not be checked "for their provisions, and no sick on board of their own "ships are ever checked of the allowance by the crown.

"From this it will be clearly seen, that the information "obtained by the person alluded to, has been erroneous or "misconceived.

"P. S.—Muster-books are not to be considered as infal-"lible, as on occasion of captures, great confusion arises "about men's names, particularly of the prisoners left in "the prize, who are likely to be altogether omitted."

It was therefore, on information, in every particular erroneous, that Dr. Bancroft ventured to charge Mr. Wilson, surgeon of the Hussar, with falsifying those statements, upon which I grounded my argument in favour of the contagious nature of the yellow fever.

There are a number of other inaccuracies of inferior importance charged upon him; and also on the surgeon of the hospital, to whom Dr. Bancroft will not allow even the faculty of eye-sight in discovering the colour of the men's skins. Many of these are likely to be real; and still more industry might have furnished still more aliment for captious cavilling; particularly had Mr. Wilson so far forgot what was due to himself, as to have submitted to the endless humiliating interrogatories put to him. It would be strange indeed, if in ordinary circumstances inaccuracies did not occur on such occasions from hurry and confusion, but when the dismay of pestilence was added to that of war in some of its roughest forms, it would be incredible were any one to assert that inaccuracies had not happened. It does not seem to have occurred to Dr. Bancroft to make any allowance for these circumstances.

I ought not to omit, that soon after I heard of the truth of these transactions being denied, I called on Captain (now Sir John) Beresford, who commanded the Hussar. He assured me that Mr. Wilson's statement was correct in every point; adding, that having had the yellow fever himself, he well knew what it meant. He informed me farther, that, after the sick were sent to the tents, he himself, his officers and men in health, went also on shore under tents at a prudent distance from the sick, and remained there till the ship was thoroughly cleansed, purified, and fumigated, the whole ballast being taken out, and the hold swept.

What now becomes of the vaunts of our author, exulting in the victoriousness of his cause,* and of the many encomiums of his partisans, proclaiming his statements to be infallible, and his arguments to be unanswerable? Were we to judge him with one half of the severity with which he has judged others, or were we to take this as a specimen of the reasonings with which his voluminous writings are swelled, what opinion should we form of the correctness of his facts and the accuracy of his research? I do not mean to arraign Dr. Bancroft of that wilful falsehood which he so unsparingly imputes to Mr. Wilson and others. He merely believed what he was told by a clerk in office, as ignorant as himself of the practical usages of actual service. I have here no personal exceptions, much less any hostile feelings.

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* This author's opinion of himself and his cause, will be readily inferred from the following copy of the introductory sentence to the sequel to his Essay on the Yellow Fever, published last year, 1818. "In the year 1811, I published an Essay on the Yellow Fever; and, "by *facts not to be invalidated, while truth continues to be invariable,* "proved it to be no other than an aggravated form of that multifarious "disease, which is well known to result from the action of those "exhalations commonly denominated marsh miasmata, though often "extricated from soils and situations, which are not marshy, &c."

He has only questioned my accuracy and judgment, points of criticism, upon which all publick men are fairly accountable. He has been pleased even to mention my name with respect. But I here earnestly deprecate, nay, loudly protest, in my own name, and that of all those who value the dignity and respectability of the profession, against those arguments on professional subjects, which consist in aspersions on moral rectitude: character being a possession dearer to every man of good principles and sentiments, than life itself; and calumny being, of all wrongs, the most difficult to repel, and that which admits the least of atonement or redress.*

In order to obtain still further information on this matter, I inspected the captains' journals of the Thetis and Hussar, deposited at the Admiralty Office; and also the account of the engagement, as detailed in the London Gazette, of the 27th of June, 1795. In the captain's journal of the Thetis, the number of prisoners in the Hussar, is stated at 130. In the captain's journal of the Hussar, they are stated at 125. We have seen, that the number stated in the muster-book of the Hussar, and of the charge for head-money, was 116. In the victualling-books, they are stated at 117.

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* The high value here set upon honest fame, is no extravagant and romantic notion, derived from the ages of chivalry. The justness of the sentiment can be maintained not only on ancient classical authority, but it has the sanction of Holy Writ. The Roman satirist says,

> Summum crede nefas animam præferre pudori,
> Et propter vitam vivendi perdere causas.

And we find from the etymology of a scriptural word, the horror, in which the depriving any one of his good name ought to be held. Διάϐολος derivatur a Διαϐάλλω, calumnior. The verb in this sense occurs in the works of Xenophon, Demosthenes, and Aristophanes; but the derivative διάϐολος is not to be found in any profane author, and is a word purely scriptural. This attribute is, I believe, by many serious persons deemed not to be the worst which enters into the character of this malignant being; but it would appear that the Evangelists thought it one of the most descriptive, by coining this new vocable by which to designate him.

Incorrect, and apparently inconsistent, as these various statements may be, they nevertheless admit of the following explanation.

The Thetis being the Commodore's ship, all the important documents belonging to the prizes, would be carried on board of her, and among the rest, the *rolle d'équipage*, containing the names and number of the men on board, when the ship took her departure from Guadaloupe, which was probably 130. The number on the captain's journal of the Hussar, was probably taken from the number, when the ship went into action, as nearly as they could ascertain, this being an important point, for it is the number on which head-money is strictly due. This was 125. The number on the muster-book, 116, was the number of survivors after the battle; part of whom, as usual, would be transferred to the victor, and part left behind, but all equally entered on the books, as already stated. Among those left behind, would certainly be the wounded, for that there were wounded as well as killed, it is impossible not to believe; for, it is stated in Captain Cochrane's letter, in the London Gazette, that the frigates did not open their fire, till they were within half musket-shot. And there is this farther proof of the closeness and severity of the conflict, that the wounded bear a smaller proportion to the killed, than in any action I ever knew: the former, being in the Thetis nine; and the latter, eight. The proportion of the wounded to the killed, is a sort of criterion of the distance of contending ships, on account of the number of splinters from spent shot, when they are less closely engaged.*

I should say, therefore, that the difference between the number at departure, 130, and the number in going into battle, 125, was the number of those who died on the passage, being five; that the difference between the number which went into action, 125, and the number on the muster-book, 116 or 117, is the number killed in action, being eight or nine. With regard to the head-money, it is evident, the captors had not what was due to them, which was probably owing to its having been paid long afterwards in London, and the number being taken from the muster-books at the Navy-Office.

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* See Dissertation II. page 77, of this Volume.

But it may be asked, why all this discussion regarding historical incidents? Is there not sufficient internal evidence in this case, to repel the charge? For, is it conceivable, that Mr. Wilson, whose character is that of a man of honest simplicity of mind, could, without any assignable or adequate motive, become at once so flagitious, as to invent such a systematick machination; or had he been capable of conceiving such a purpose, would it have been possible for him to have blinded and deluded so many enlightened persons, professional and unprofessional?

It now only remains for me to vindicate myself, if I can, from an obvious charge which may be brought against me. It may fairly be asked, why, with my convictions on this subject, I should for seven years, have suffered the world to be imposed on, in a point of the highest importance, by statements, the fallacy of which I had ample means at any time of demonstrating.

In the first place, from my utter abhorrence of professional controversy, and having, through life, never publicly noticed the various obloquies, misconstructions, and contradictions, to which every man, in the exercise of his publick duties, is exposed, I was in hopes, at the end of my life, to be able to say, that I had never, through the medium of the press, taken part in any professional contention. I was perhaps vain enough to think that my character might have proved some sort of shield and answer to them.

If it should be said in reply, that this may be a very good rule in the case of private injuries; but in cases, where the best interests of society, and the lives of myriads are eventually at stake, there is no room for pleading indolence and the love of peace, far less an over-weening conceit of character. To this I could only rejoin, that I trusted that before long, the native force of truth would operate and prevail, especially as the cause was supported by advocates more able than myself. And I believed a few years ago, that this golden era had actually arrived; for it did not occur to me, how any doubts on this subject could possibly remain on the mind of any rational being, after the publications of Sir James Fellowes, Mr. Pym, Sir Joseph Gilpin, and others. But I was mistaken. Much as I had studied the human mind, much as I have striven to measure the extent, as well as variety, of its aberrations in all their dimensions, I had not, it would appear, duly fathomed the length and breadth, nor sounded the depths of self-delusion, and the pertinacious pride of opinion; for, within these few months, there have appeared publications, as full of sectarian zeal, of plausible and imposing language, as at any period; and I am well assured, that they have even made converts. I should as soon hope to argue a bigot out of his belief of the most absurd tenet of his creed, as to change the opinions of the leading partisans of this doctrine.

To those who are not acquainted with the history of this controversy, it is necessary to offer a still further explanation of the motives of the Author in thus republishing his original dissertation in all its fullness, after saying, in the second edition, that in consideration of the opposition to the opinion of the existence of contagion having nearly ceased, he had greatly abridged* that discussion, and gladly suppressed all his animadversions on Dr. Bancroft's conduct. It has been seen, that the Author found himself grievously mistaken regarding the opinions and practices of the non-contagionists, not only in Europe, but in North America nd the West Indies. It is notorious, that in the course of he two last years, many thousands of human beings have erished miserably at Barcelona and the Antilles by the eglect of preventive measures; and there are still profes-ional persons in the United States of America who hold quarantines to be unnecessary. There is also a peculiar incitement to the Author to republish the case of the Hussar frigate, for if it can be proved beyond a doubt, even in a ingle instance, as already adverted to, that the disease can be communicated from one ship's crew to another, in the middle of the ocean, the question is decided.

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* The Article was reduced from 70 to 17 pages.

The Author has, in the whole course of this controversy, given the most unequivocal proofs of his extreme reluctance to engage in it; and wished more particularly to observe all possible tenderness towards the individual who took the main lead in opposition to him; and he is confident that this gentleman will be fully convinced, that nothing but the most over-powering dictates of duty could urge him to a measure which could not be omitted but by a compromise of conscience, and an insensibility to the eternal obligations of truth and humanity.

The sole purpose of this Dissertation has been to establish the reality of contagion. The Author has been discouraged from entering into questions of curative practice, by the great fallacy and inefficacy of all means that have been hitherto proposed, and he has none better to offer. But before taking leave of the subject, he will briefly advert to a few practical points.

The first he will mention is, that he has some reason to believe that a course of mercury, previous to entering the Carribean station, has the effect of removing, or at least of lessening the susceptibility to the yellow fever. The chief fact upon which he founds this, is what occurred in one of the ships of war which arrived in the West Indies towards the end of the American war, in which a great proportion of the crew had been under a course of mercury on the passage; and it was remarked, that after these men arrived and were exposed to the same course of sickness as the others, they were the only persons who escaped the fever of the climate. It would appear, that the mercury had reduced their constitution to the standard of the coloured and Creole inhabitants, and of the seasoned Europeans. The Author has no experience of his own on this subject, and leaves it to others to pay such regard to it as their own judgment may dictate.

The other remark he has to make, respects certain violent methods of practice which have been followed, even at a very late period, in the tropical fevers. He alludes particularly to the severe depletory remedies of bleeding and purging, especially the former, which have been employed without that discriminating judgment which is indispensable in all sound practice. His attention has been very strongly drawn to this subject, by lately reading the detail of a most afflicting case of a young naval commander, on the West India station. He was seized a few weeks after his arrival with a continued fever, the symptoms of which were by no means violent or alarming, nor was he of an athletick frame. The practice followed was that of bleeding every day, from one to two pounds for the first four days of his illness, and two pounds two days before his death, which happened on the sixth day. The whole quantity of blood abstracted amounted to a gallon. He was also repeatedly and severely purged with salts and calomel. This is the revival of a practice, which had been tried and abandoned on account of its want of success, at the beginning of the great epidemic in 1793. The Author does not mean here to explode depletory remedies in all cases; on the contrary, he is well assured, from his own experience, and that of others, that a single bleeding in the first day, or at farthest, the second day of attack, may be highly useful in the case of strong plethoric subjects newly arrived from Europe. It is to be lamented, that the most cautious and judicious employment of remedies have not made any sensible difference in the general rate of mortality in this most malignant disorder; but it is truly humiliating to reflect, that it should be increased by rash and undistinguishing practitioners. Will the junior members of the Medical Service of the Navy forgive a veteran in that department, who has zealously devoted to it a large portion of a long life, for warning and imploring them not to give lightly into such outrageous and indiscriminate practices, as they regard the sufferings and value the lives of their fellow men who are entrusted to their care: not to mention what is above all price in the estimation of every good man—peace of mind, and a clear conscience.

DISSERTATION X

A Statement of Facts, tending to establish an Estimate of the true Value and present State of Vaccination.[*]

It is now twenty-one years since Vaccination was promulgated in this country by Dr. Jenner, and fifteen years since it began to produce a sensible effect in diminishing the mortality from small pox. In regard to the latter period, it is coeval with this society; yet, though no discovery in nature nor in medicine has been more important to the interests of humanity, nor any which has ever so rapidly and universally won the assent and practical adoption of mankind, there are no notices of it on our records, except in our second volume, in an article by Dr. Bateman, in which he relates a case of a mother who was affected with the small pox a second time, by being exposed to infection, from some of her own children, who had caught it casually, while her other children, who had been vaccinated, resisted it. As it is to be hoped that our labours will prove to posterity some of the principal sources of reference regarding the medical and chirurgical discoveries and improvements of the age; as it is one of the reproaches of our country, that it has not availed itself so much as any other of the benefits of Vaccination; and as there are writers among us who still allege that the failures are so numerous that the value of the discovery is very ambiguous, it seems one of the duties of this society to lend its aid in placing these important points in their true light.

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[*] The substance of this Dissertation was communicated to the Medical and Chirurgical Society in the year 1819, and published in their Transactions of that year. It was reprinted separately with some additions, in the year 1820, by the desire and at the expence of Dr. Jenner, who caused it to be distributed gratuitously by the publick establishments for Vaccine Inoculation.

It seems almost needless to premise, that the small pox is of all maladies that, which, during the last thousand years, has destroyed the largest portion of the human species, and been productive of the largest share of human misery. There is, perhaps, no disease over which medical art has less power; and this power, such as it is, has consisted more in abolishing pernicious practices, than in ascertaining any positive methods of controlling its fatality, unless we except the inoculation of it with its own *virus*. But, though the beneficial effect of this on those on whom it is actually practised is undeniable, it has no tendency, like Vaccination, to extirpate the disease; and from the impossibility of rendering it universal, it has actually been found to add to the general mortality of the small pox, by opening a new source for the diffusion of its infection.

It ought to be stated also, with a view to a decision on this question, that Vaccination itself is attended with no danger, and frequently takes effect, without any visible disturbance in the system. There is even reason to believe, that in its process it wards off other diseases, by pre-occupying the constitution.*

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* There is reason to believe that Vaccination saves from illnesses and death; for if it were not so, the proportion of deaths of those under Vaccination, ought to be equal at least to those of the community at large; nay, greater; for it is generally performed on subjects during infancy, in which the proportional mortality is much greater than on the total population. This, however, is not the case, as may be proved from the Population Returns of the metropolis. The mortality of last year amounted there to 24,310; which, on population of 1,274,800, gives a weekly mortality of 468. The population being divided by this, gives a weekly mortality of 1 in 2723; so that in this number of vaccinated subjects there ought to be, in the course of the weeks in which they are subjected to it, either

In order to bring the general question to the test of calculation, in order also to institute a comparison of the mortality of small pox as affected by Vaccination, as well as by Inoculation from itself, I have selected from the bills of mortality four periods, each of fifteen years, for the purpose of exhibiting the mortality of small pox in each of these series in regard to each other. These are thrown into the form of Tables, and subjoined to this Dissertation.

The first series, is the fifteen years immediately preceding the introduction of inoculation; that is, from 1706 to 1720, both included. Previous to this period, no account that could be depended upon regarding the small pox, could be derived from the bills of mortality; for down to the beginning of last century such was their imperfect construction, that small pox, measles, and flux were blended under one head. Exception may be taken against the accuracy of these bills, even in this improved state, particularly with regard to the discrimination of diseases. This objection, however, is certainly less applicable to small pox than any other disorder, its character being so striking as not to be mistaken by the most ignorant and careless observer.

The second series is taken at the middle of the last cen-

one death, or one mortal illness, for death ensuing two or three weeks after Vaccination, would naturally be imputed to it. But as the mortality of children under two years of age, at which time they are mostly subjected to Vaccination, is somewhat more than one-fourth of the whole amount of mortality, there ought to die weekly considerably more than 1 in 2723. But as there are no reports of the mortality of vaccinated children which will justify this rate of mortality among them, nor any mortality at all, it follows, that death and disease are in less proportion than if they had not been vaccinated. And this is conformable both to reason and experience; for it is found, that the human body will not readily take on a double morbid action; so that a safe disease, like Vaccination, may occasionally avert a more severe and dangerous one. It is also believed in Ceylon and Mexico, as well as by some British practitioners, that Vaccination cures, as well as prevents, several disorders.

tury, when inoculation had made considerable progress; that is, from 1745 to 1759, both included. In comparing this with the preceding series, with regard to absolute numbers, it ought to be taken into account, that eleven parishes were added to the bills of mortality, between the years 1726 and 1745, both included: so that the progressive improvement of general salubrity ought to be estimated still higher than what is indicated by the diminished mortality, as it stands in the Tables.

The third series comprises the fifteen years previous to the introduction of Vaccination, when inoculation had made still greater progress; that is, from 1785 to 1798, both included.

The fourth series comprises the time in which the vaccine inoculation has been so far diffused as to produce a notable effect on the mortality of small pox, that is, from 1804 to 1818, both included.

The result of these computations stands as follows:

Ratio of the Mortality of Small Pox, to the total Mortality.

From 1706 to 1720, one in 12.7; that is, 78 in 1000.
From 1745 to 1759, one in 11.2; that is, 89 in 1000.
From 1785 to 1798, one in 10.6; that is, 94 in 1000.
From 1804 to 1818, one in 18.9; that is, 53 in 1000.

Fractions are not noticed in the last column of numbers,

It appears from this statement, that the proportion of deaths from small pox to the total mortality, increased in the course of last century; so that inoculation seems to have added to the mortality. It is but fair to mention, however, that this total mortality is not quite a just scale whereby to measure the relative mortality of small pox; for in the course of that century, the general mortality itself was greatly diminished in relation to the population. This diminution of general mortality was chiefly owing to the diminished mortality in children under two years of age, which, at the time when the account began to be kept, 1729, averaged about

9000; but at the end of the century not more than 5000;* also to the decrease of fevers, and still more of fluxes. The relation of the mortality of small pox to the population, would therefore be a more fair criterion of its increase or decrease. In this view it might, at first sight, be thought that it had decreased: for the population of the metropolis nearly doubled in the course of the last century. But it is to be remarked, that there has been little increase of population in that portion of the metropolis which is included in the bills of mortality; the great increase having been in the parishes of Mary-le-bone and St. Pancras, which are not included in these bills. It is computed in the remarks subjoined to the last parliamentary returns of population, that the population of London, within the walls, had decreased more than three-fifths in the course of last century, from the widening of streets, the erection of public buildings and warehouses, and, it might have been added, from the migration of mercantile families to the west end of the town. As a set-off to this, there has certainly been a great addition, in the same time, to those parishes within the bills, which stand on the verge of the metropolis, such as St. George's Hanover Square, St.

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* This diminished mortality of young children is, like that of fevers and fluxes, owing chiefly to the improvements in ventilation and cleanliness, but greatly also to laying aside the custom of exposing them to the open air in winter and early in spring; either from inadvertency, or from the false notion of rendering them hardy, whereas they thereby catch inflammations of the lungs. Nothing tends more to the health, strength, and growth of children than genial warmth. It seems chiefly owing to the great plenty and cheapness of fuel, that the race of people in Lancashire is so superior in their form and size. In Buckinghamshire, on the contrary, where fuel is extremely scanty and dear, the race of people is small and puny, insomuch that it is provided by Act of Parliament that men shall be admitted into the militia of a smaller stature in this than other counties. This complaint has of late years been greatly alleviated by the inland navigation conveying coals by canals.

George's Bloomsbury, Poplar, and Stepney. But the addition to the population, if any, within the bills of mortality, does not seem to be so considerable as to affect the computation. And, if this is admitted, the absolute numbers of the deaths from small pox, estimated in relation to the population, that is, exactly as they stand on the Tables, afford a fair comparative statement of the mortality in the last century, and seem to prove that inoculation has not added so much to it as has been alleged. It was in the rural population that the effect of inoculation in diffusing small pox was chiefly felt. In this situation there is much less intercourse of persons with each other than in towns, so that not only many individuals escaped from their not being exposed to infection during their whole lives, but whole districts were known to have been exempt from it for a long series of years, before it was universally diffused by inoculation.

But the truly important result from these statements consists in the clear, undeniable, and great diminution of it since the Introduction of Vaccination. It appears, that in the last fifteen years, the mortality from small pox, in the bills of mortality, has not been much more than one-half of what it was in the two like series of years in the middle and latter end of the last century. Nor does this comprise the whole benefit derived from this discovery in the metropolis; for, besides that the sixth part of it lies without the bills, it was found, in levying the tax on burials for the last six months of 1794, that the number of unregistered deaths, chiefly those of dissenters, amounted in that half year to 3148; and the reporter of the parliamentary enumeration thinks that, as besides these there were undiscovered interments, the unregistered deaths may be computed at one-third of the total mortality, that is, about 7000. (*See Abstract of the Parish Registers*, 1811, *printed by authority of Parliament, page* 200.)

Assuming, therefore, that Vaccination had not been practised the last fifteen years, and that the mortality from small pox, within the bills, had in that time, that is, from 1804 to 1818, been the same as from 1784 to 1798, that is 27,569 in place of 14,716; and assuming that there has been the same proportional diminution of deaths in the districts without the bills, and among the unregistered subjects, the account of lives saved in this metropolis by Vaccination in these fifteen years, will stand as follows:—

Within the bills of mortality . .	12,853
Without the bills of mortality . .	2,570
Unregistered cases	7,711
Total . .	23,134

The first of these numbers is found by subtracting the amount of deaths by small pox, in the bills of mortality, during the practice of Vaccination, from the amount of them during the same number of years, immediately before the discovery of Vaccination.

The second number is found by dividing the first by 5. The population of the metropolis without the bills is stated at one-sixth of the whole, which is evidently one-fifth of that within the bills.

The third number is found by dividing the sum of the two others by two; the unregistered cases, being, as before stated, one-third of the whole.

It appears, therefore, that even under the very imperfect practice of Vaccination which has taken place in this metropolis, 23,134 lives have been saved in the last fifteen years, according to the best computation that the *data* afford. It will be seen, by an inspection of the Table, that in that time there have been great fluctuations in the number of deaths. This has been owing partly to the small pox inoculation of out-patients having, by an unaccountable infatuation, been kept up at the Small Pox Hospital for several years after the virtue of Vaccination had been fully confirmed. The greater number of deaths in 1805 may chiefly be referred to this cause. Since the suppression of this practice, the adoption of Vaccination, though in a degree so incomplete, in consequence of public prejudice, created entirely by mischievous publications, has been unable to prevent a considerable, though fluctuating, mortality from small pox. The late mortality from small pox, though little more than one half of what it was in former times, might have been entirely saved, if Vaccination had been carried to the same extent as in many cities and whole districts on the continent of Europe, in Peru, and Ceylon.

In the summer of 1811 the Author was called to visit, professionally, Don Francisco de Salazar, who had arrived a few days before in London, on his route from Lima to Cadiz, as a deputy to the Spanish Cortes. He informed him, that Vaccination had been practised with so much energy and success in Lima, that for the last twelve months there had occurred, not only no death from, but no case of, small pox; that the new-born children of all ranks are carried as regularly to the Vaccinating House as to the font of baptism; that the small pox is entirely extinguished all over Peru; nearly so in Chili; and that there has been no compulsory interference on the part of the government to promote Vaccination.

It is now matter of irrefragable historical evidence, that Vaccination possesses powers adequate to the great end proposed by its meritorious discoverer, in his first promulgation of it in 1798, namely, the total extirpation of small pox. The first proof of this was at Vienna, where, in 1804, no cases occurred, except two strangers, who came into the city with the disease upon them. In 1805 there did not occur a single death from it in Copenhagen.* Dr. Sacco, the indefatigable superintendent of Vaccination in Lombardy, stated, in his annual report, 3rd January, 1808, that the small pox had entirely disappeared in all the large towns in that country; and that in the great city of Milan it had not appeared for several years. Dr. Odier, of Geneva, so favourably known for his high professional, scientific, and literary acquirements, testifies, that, after a vigorous perseverance in Vaccination for six years, the small pox had disappeared in that city and the whole surrounding district; and that, when casually introduced by strangers, it did not spread, the inhabitants not being *susceptible*. The Central Committee in Paris testify, in their Report of 1809, that the small pox had been extinguished at Lyons and other districts of France.

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* See Pfaff Neuen Nord v. Archiv. B. I

These are selected as some of the earliest and most remarkable proofs of the extirpating power. But it is demonstrable, that if at the first moment of this singular discovery, at any moment since, at the present or any future moment, mankind were sufficiently wise and decided to vaccinate the whole of the human species who have not gone through the small pox, from that moment would this most loathsome and afflicting of all the scourges of humanity be instantaneously, and for ever, banished from the earth.

It is farther manifest, that extirpation being the ultimate aim of this discovery, and there being the fullest historical and practical evidence of its being capable of accomplishing this end, all other questions with regard to its expediency must be futile and irrelevant. It is in the nature of all morbid phenomena to be liable to exception. One of the most essential and characteristic laws of small pox itself, namely, that of its affecting the human subject but once in life, is found in rare cases to be violated. It is, therefore, perfectly conformable to analogy, and naturally to be expected, that it may not in all cases be a complete security against small pox. But it is obvious, that, admitting these exceptions to be very frequent, much more so than the recurrence of small pox after small pox, this can constitute no objection to the practice, as long as the extirpating power remains unimpaired and unimpeached. Nay, it is obviously so far from an objection, that it ought to operate as a powerful additional incentive on every benevolent mind, to push Vaccination to the utmost, as rapidly as possible, in order that those who are still susceptible, either from peculiar natural constitution, or from the unskilful manner of conducting the operation, or from defective matter, may not, by any possibility, catch it; for, in the event of its extirpation, it could nowhere be met with. And in order to stimulate the good and the wise to aim strenuously at this consummation, let it be constantly borne in mind, that the adversary they are contending with is the greatest scourge that has ever afflicted humanity. That it is so, all history, civil and medical, proclaims: for, though the term plague carries a sound of greater horror and dismay, we should probably be greatly within the truth in asserting, that small pox has destroyed a hundred for every one that has perished by the plague.

It is true that in its last visitation of this metropolis, one hundred and fifty-four years ago, it carried off 70,000 victims in a few months; but since that time, the deaths from small pox, recorded in the bills of mortality, haved amounted to more than 300,000; and a like number of the survivors have been afflicted with blindness, deformity, scrofula, or broken constitutions, which is not the case with the survivors of the plague. It appears, by a report of the hospital for the Indigent Blind, that two-thirds of those who apply for relief have lost their sight by the small pox. It is alleged by some of the soundest Political Economists that small pox does not diminish the numbers of mankind, nor Vaccination increase them; for population is determined by subsistence, and the indefinite powers of procreation soon repair the ravages of disease. But, however true this may be, the miseries incident to so many of those who survive small pox, whereby they become a burden to themselves, their families, and to society, render this disease uncontrovertibly an evil of the first magnitude, not to mention the intense sufferings and afflictions inseparable from it; and in this view of the matter the objection seriously adduced against Vaccination by one of its opponents,* that *small pox is a merciful dispensation of Providence for the poor man, by diminishing the burden of his family*, will not hold good, for the burden is not removed.

And when it is considered that there are large portions of the globe, India, China, even one whole quarter of it (North and South America), besides all the tropical and arctic regions, in which the plague has never been known; and that in all the countries liable to it, it seldom appears but at one season of the year, and in some at long intervals, the ravage which it makes is trifling when compared with the unceasing havoc of small pox, which spares no nation in any climate, or at any season. Yet the Legislative regulations for excluding and checking the plague are of the most harsh and despotic description, while the law touches upon small pox comparatively with the most lenient hand. It ought to be generally known, however, that in a late trial and conviction, it was laid down by the judge to be the law of the land, that a medical practitioner who neglects to exclude the person whom he inoculates from communication with others, is liable to fine and imprisonment. Morally considered, indeed, it is difficult to conceive a higher degree of flagitious turpitude than that of a professional person, in the present state of knowledge, exposing his fellow-creatures, from sordid motives, to one of the most grievous calamities of which human nature is susceptible.

The preceding reasoning is grounded on the supposition of extirpation: but, however demonstrable the *possibility* of extirpation may be, it may not in all communities be *practicable*; and may not these alleged failures so operate, as, in such circumstances, to render the expediency of the practice questionable?

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* See Serious Reasons for uniformly opposing Vaccination. By John Birch. London, 1807.

In order to decide this, let the nature and amount of these failures be ascertained and estimated.

The description of those cases of small pox, (if they can be called so), which occur in vaccinated subjects, is shortly as follows:—The invasion and eruption in every respect resembles that of the genuine small pox. I have seen it attended with high fever and a thick crowded crop of *papulæ*, such as precedes the most severe and dangerous cases of the confluent kind. This runs on till the fifth day from the eruption, both days included, at which time some of the *papulæ* begin to be converted into small sized pustules. The disorder then abruptly stops short. On the following day the fever is found to have subsided, with a shrivelling and desiccation of the eruption, and recovery proeeeds without the least danger or inconvenience. The face is marked, for some time after, with brown spots, but without pits. It should never be forgotten, that all morbid *phenomena* are full of varieties and exceptions. Accordingly, though the fifth day is the most common limit of this disorder, it sometimes stops short on the third; sometimes not till the sixth or seventh; and, in a very few cases, it has been known to run the common course of small pox What forms the strong line of distinction from proper small pox, is that, with a few exceptions, it does not advance to maturation and secondary fever, which is the only period of danger. I am not prepared to deny that death may not have occurred in a few instances; nay, there seems sufficient evidence that it actually has; but these adverse cases are so rare, as not to form the shadow of an objection to the expediency of the general practice. A few weeks ago, at a meeting of this Society, at which forty members and visitors were present, I put the question whether any of these eminent and extensive practitioners had met with any fatal cases of this kind. Two gentlemen had each seen a single case, and two other gentlemen took occasion to say that they had each seen a case of second small pox, both of which proved fatal. It is evident, therefore, that according to that maxim which guides mankind in the conduct of life, namely, that of acting on a general rule and average, and not on exceptions, these adverse instances ought not to have the least influence on practice, even though they were much more numerous, and though every one of the alleged failures were authentic cases of real small pox. Nor indeed do they, except in the very rare cases here cited, deserve the name of failures; for, though they fail in preventing *small pox*, they do not fail to prevent *death*. And let me here, in the name of humanity, beseech practitioners not to be forward in publishing single cases of failures, whether real or supposed; for, when the weak minded and uninformed hear of these failures, without hearing at the same time that there are hundreds of cases of permanent security for every single case of failure, they are guided by the *exception*, which becomes to them the *rule;* their judgments being thereby most fatally perverted.

As it is of the utmost consequence to establish the strong and important distinction between small pox, properly so called, and that which takes place after Vaccination, which may be called the imperfect, or five day small pox, a few of the most impressive testimonies respecting the safe nature of the latter may be here recited. Mr. Brown,* of Musselburgh, gives the detail of forty-eight cases, in none of which did the secondary fever nor death occur. Here was a saving of at least eight lives, at the lowest computation; for this is the number which, by the average mortality of natural small pox, would have died if the constitutions of these forty-eight persons had not been modified by previous Vaccination. Dr. Dewar of Edinburgh, hearing that many vaccinated subjects had been affected with small pox at Cupar in Fife, where the natural small pox at the same time prevailed, he most laudably repaired to the spot to investigate the subject. He found that fifty-four vaccinated subjects had caught the small pox. All these, except one, had the imperfect or five day eruptive fever, and lived. The fatal case was that of a child, who had a complication of other disorders, and having died on the fifth day, the small pox, according to its ordinary course of fatality, could not of itself be the cause of death. All the rest were safe; while of sixteen cases of the natural small pox at the same time and place, six died; so that, if these fifty-three cases had not undergone the mitigating process of Vaccination, nineteen or twenty would have perished. Between thirty and forty cases of the same kind have occurred at Carlisle, on the testimony of Dr. Barnes, a respectable practitioner of that city.* Many proofs might be adduced from the oral testimony of private practitioners, which would over-swell this article. The only other to be mentioned is from the report of the Central Committee of Vaccination at Paris, made in December last, in which the description of the disease occurring after Vaccination corresponds exactly with the imperfect five day cases which have occurred in Britain. They refuse the name of small pox to it; but as I know from my own observation, as well as from the testimony of others, that the matter from it does by inoculation give the small pox, we can hardly, perhaps, with propriety deny it that name; but it should be distinguished by some strong discriminating epithet, such as is suggested above.

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* See Inquiry into the Antivariolous power of Vaccination. Ed. 1809. There is an Article in the Edinburgh Medical Journal by the same gentleman in 1819, in which he mentions that he had heard of several deaths having occurred from cases of small pox after Vaccination. But, admitting this, it is utterly incomprehensible by what process of reasoning Mr. Brown could, on such premises, arrive at the conclusion that Vaccination ought to be exploded and abandoned.

In order to place the whole of this in a clearer view, I shall here as succinctly as possible enumerate the most remarkable irregularities of small pox belonging to itself, and in the mutual relation of it with its kindred exanthematous affections, cow pox, and chicken pox.—First, the great difference between one case and another of small pox, whether casual or inoculated, in point of mildness and malignity, depending on the difference of individual constitution or idiosyncrasy, as it is technically called.

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* See also a clear and able exposition of this subject in the Medical and Surgical Journal of Edinburgh for July 1818, by Mr. Dunning, of Plymouth.

Secondly, The liability of a few constitutions to suffer a recurrence of it a scond time, and even oftener.*

To these renewed attacks I would apply the epithet *second*, or *recurrent*, in preference to that of *secondary*, which implies, if I mistake not, some difference in kind, and not merely repetition or recurrence, as is the case here; for these second attacks are cases of as genuine small pox, as those of the first attack. There is only this remarkable difference in these cases from those of ordinary small pox, that they are above the average rate of severity which takes place in first attacks. And it is further remarkable, that those first attacks which have sooner or later, in very rare instances, been suceeeded by a second attack, have also been cases of uncommon severity, the contrary of which might be expected *a priori*. I ventured to mention this from my own observation† some years ago, and I find it confirmed by the very ample records quoted by Dr. A. Smith.‡

Thirdly, The great abatement of malignity by the inoculation of it with its own *virus*. The title *mitigated*, seems most applicable to this kind of small pox, rather than that of modified or imperfect, for it is identical in its specific nature with that which is caught casually, the whole series of phenomena being the same, but on a lower scale of intensity.

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* This has been no where that I know so well traced and ascertained as in a tract of great erudition, by Dr. Andrew Smith, subjoined to Dr. John Thomson's Historical Sketch of Small Pox, Edinb. 1822.

† See an Article on Infection, in the 3rd volume of Transactions of the Society for the Improvement of Medical and Surgical Knowledge. Lond. 1212.

‡ See further remarks on this subject, at p. 209 of this work.

Fourthly, There is a sort of small pox which not unfrequently occurs, sooner or later after Vaccination, to which I would affix the epithet of *imperfect;* for though it is perfectly similar to the ordinary small pox in its first attack, it stops short at the termination of the eruptive fever, not proceeding to the dangerous stage of complete eruption and secondary fever. Its identity, however, is ascertained by the matter taken from the incipient and immature pustules, producing the ordinary small pox as perfectly as the ripe matter taken from genuine small pox. Of this I have had personal observation. And here it is of the utmost importance to remark, that that deviation from the ordinary course of nature, whereby the vaccine inoculation does not in all cases afford complete protection, is sufficiently accounted for by those exceptions, varieties, and peculiarities, so eminently displayed in all the phenomena of animal life, particularly in the diseases incident to the human frame, and above all, in whatever relates to infection. This consideration, while it puts an end to all the wrangling and angry feelings among the members of the medical profession, as exemplified in their contests respecting spurious matter, and errors in the operation being the causes of failure, tends to establish unanimity and satisfaction in the community at large, by removing all vain alarms. Nothing inconsistent with truth and candour can be substantially and ultimately serviceable to any cause; and here it is required that we should not only admit, but avow and proclaim, that Vaccination is, in many constitutions an imperfect protection against small pox infection; but it ought equally to be promulgated, that the small pox occurring after Vaccination, is so rare, and at the same time so safe, as to furnish no objection to the practice. The publick ought also to be told, that though all the cases of failure, multiplied and exaggerated as they have been by ignorance, selfishness, and malignity, were strictly true, even this would prove no solid objection; for thousands of cases of complete protection could be adduced for every single case of alleged failure; and though a case of malignant and fatal small pox should occur after the most perfect Vaccination once in ten thousand cases, it is only what might be expected, and even might have been predicted, as an incident in accordance with the nature of small pox infection. And it will not be disputed, that this loss of one life is compensated by the protection afforded to 9,999 others, of whom 1,666 would have died, had they been affected with casual small pox, one in six being the lowest computation of its mortality.

Fifthly, and lastly, The other form in which small pox is alleged to shew itself, is that of Chicken Pox, and other anomalous eruptions. From these making their appearance only, or chiefly, at times and in places in which small pox is epidemic, it is believed that they depend on the influence of variolous infection, acting on constitutions under particular circumstances of susceptibility. This has been ably investigated by Professor John Thomson, of Edinburgh; but as it is a subject of great intricacy and obscurity, and as the sole object of this Dissertation is to exhibit a popular and practical view of the subject, in as concise a form as possible, the Author must be excused from dilating on this point, though it is one of considerable curiosity and interest. He does not mean to deny that it belongs to the kindred of small pox; but there is one circumstance, namely, its not communicating that disease by inoculation, which places an insuperable line of demarcation between it, and those which have been above styled the recurrent mitigated, and imperfect forms of this disease.*

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* See the subject fully treated by Professor Thomson, with his characteristick industry and acuteness, in his account of the Varioloid Epidemic. Edinb. 1820, and his Historical Sketch of Small Pox. Edinb. 1822.

The only further remark to be made on this part of the subject is, that when the presence of small pox does not render prompt Vaccination advisable, it would be expedient to defer it in subjects labouring under herpetick and impetiginous affections, as it is apt in such cases to excite anomalous eruptions. It is also worth while to mention, that there is a simple and ingenious method of being assured of the perfect state of the vaccine operation, proposed by Mr. Bryce, of Edinburgh. This is to inoculate the patient on the other arm from his own matter, about the fourth or fifth day of the pustule. If this second inoculation produces a hurried and irregular pustsule, it is a proof that the first inoculation has had its due effect. But if the second insertion produces a regular eruptive process, it is a proof that the first had failed in its effect.

As the attack of small pox in subjects who have undergone Vaccination, generally occurs after a long interval, it becomes a question, whether this is owing merely to the chance of such subjects not having been exposed to variolous contagion, or to the effect of time in diminishing the antivariolous virtue of Vaccination. The former is certainly conceivable; but when we consider the numberless severe proofs to which the recently vaccinated were experimentally exposed in the early part of this practice all over Europe, from which the most satisfactory evidence resulted; and when it is considered that, in the great majority of cases, small pox has not occurred till several years after vaccination, it seems by far most probable that the virtue of it is weakened by time. When parents, therefore, become anxious and apprehensive regarding the risk of small pox after a lapse of years, it seems quite reasonable that they should be indulged in having the operation repeated.

Let all this be applied to the case of a community, in which the total eradication of small pox is quite hopeless. Let it be admitted that such occurrences as have been described do frequently occur: let it even be admitted, for argument's sake, that every vaccinated case whatever must of necessity and unavoidably at some time or other in future life be affected with this mitigated and imperfect species of small pox, would it not even, under this great abatement, be one of the greatest boons that could be conferred on humanity, being an instrument or remedy which would disarm small pox of its danger? Would not the next greatest benefit to the total extirpation of small pox, be the stripping it of its terrors by rendering it safe and harmless?

It may be further remarked, that the benefit derivable from the different proportions of the persons vaccinated to the total population, advances in a considerably higher progression than the simple arithmetical. It is evident, that the smaller the relative number of the vaccinated, the greater their chance of meeting with small pox infection; and that though the disease which they may catch is of a very safe nature, it would nevertheless be desirable to avoid it on its own account, but still more on account of the prejudice it creates. This, in the eye of general benevolence, constitutes an additional, though secondary motive for extending the vaccine inoculation as widely as possible, even though the attainment of the *maximum*, that is, total extirpation, should be impracticable and hopeless.

It is of the highest importance to society, that this subject should be seen in its true light, and in all its bearings; for the frequent occurrence of these cases of small pox, however safe in themselves, have had a most pernicious effect on the credulous and ignorant, by giving a check to the practice of Vaccination. It ought never to be forgot, that the power of Vaccination in extirpating small pox being established, the question of its expediency is completely set at rest. How many parents are there now who, from a weak distrust in the virtue of Vaccination, have to lament the loss of a child from small pox, either casual or inoculated? Many such are known to myself. It is pleasing however, to observe, that though this unmerited discredit into which Vaccination had fallen, swelled the number of deaths in London from small pox to 1051 in 1817, good sense is likely still to prevail, for last year (1818) the deaths have fallen lower than they have ever been known since the institution of the bills of mortality, the total number being only 421.*

On the whole matter, I believe I am speaking the language of every man of good principles and feelings, capable of reflecting seriously and considerately on the subject, when I say, that whenever he applies his mind to it, he finds some new and increasing causes of complacency and satisfaction. Viewed as a mere physical fact in the natural history of the animal kingdom, the virtue of the vaccine *virus* in resisting the action of the *variolous*, is, by its novelty and singularity, highly striking and interesting to every one whose taste leads him to take delight in contemplating and exploring the devious ways and varied courses of Nature, as curious exceptions to the uniformity and constancy of her laws. One can hardly contemplate with sufficient astonishment the extraordinary fact, that a morbid poison taken from a domestic animal should, when inserted into the human body, shield it against the assault of one of the most fatal and cruel maladies to which it is liable. But the importance of this, as a physical curiosity, vanishes to nothing, when the unexampled benefits of it to mankind are fairly weighed; benefits which could never have been dreamt of by the most sanguine philanthropist, who, in contemplating it, finds himself lost in astonishment, as a boon to mankind almost beyond the grasp of his mind duly to appreciate: so that what seems at first sight merely a sportive aberration from the usual course of things, has, by the wise dispensation of Providence, become subservient to the most beneficent purposes: and how many more useful discoveries may there yet be in reserve for the alleviation of human misery, from obscure and undetected facts still lurking under the very surface of nature! It will in the eyes of future ages be deemed an *epocha* in the destinies of the world, and one of the highest boasts of the country in which it took its rise, with a sense of unrequitable obligation to the individual* who first disclosed and promulgated the secret, by drawing it from the dark recesses of rural tradition, and rendering it available to the whole human race.

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* Since the first publication of this Tract, it has appeared that in the succeeding year (1819), the deaths from the Small Pox had advanced to 712; which ought to add to the perseverance, zeal, and vigilance, of the friends of humanity in prosecuting Vaccination.

Such are the sentiments which must fill every well constituted mind; and it behoves the whole medical profession, which has already done itself so much honour by the zealous and disinterested encouragement afforded to it, to continue its efforts in eradicating every remaining prejudice against it. It becomes Englishmen, in particular, to cherish it, not only as the native offspring of their country, of which they have reason to be proud, but to redeem the character of the nation from the reproach of having, of all others, whether savage or civilized, done the least justice to this noble discovery. It is somewhat humiliating to reflect, that while there is no country which has received more striking and unambiguous benefits from this discovery, there is none which has prized it less, nor availed itself of it so little. I here allude to the unspeakable advantage of it to the public service, both by sea and land, in the late war, so eventful and portentous in its course, and so glorious in its termination. Formerly, small pox was one of the greatest embarrassments to the operations of armies; and ships of war were occasionally under the necessity of quitting the sea, from the prevalence of this disorder among their crews. Those lately at the head of the navy and army, with that vigilant wisdom and humanity which become those who direct the affairs of a great and enlightened nation, recommended and enforced the practice of Vaccination in both these departments, to the great furtherance of the public service. Their example has by no means been followed among the civil population of England. This is chiefly imputable to the abuse of the press, the general licentiousness of which may be denounced as one of the most grievious evils of this age and country, in regard to other subjects interesting to humanity and public happiness, as well as this; the votaries of error and depravity being more successful, because they find more encouragement in disseminating their principles, than the advocates of truth, virtue, and good order. There is no maxim more true, than that the best things do become by abuse the worst, and that in proportion to their excellence. What a mortifying contrast does England form with Peru, where it was adopted instantly, in consequence of a flash of conviction from the light of evidence! And was not this conviction fully justified by the immediate disappearance of small pox from that whole region? To those nations who may feel an envy of the glory attached to our country by this discovery, it must be no small consolation to perceive that a large proportion of the English nation has hitherto been so besotted as not to know how to appreciate it, nor how to avail themselves of it, and that it has encountered more opposition among ourselves than in all the world besides.

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* Dr. Edward Jenner.

TABLE I.

Years.	Total Mortality.	Mortality from Small Pox.	Proportion.	Proportion to 1000.
1706	22,097	1094	1 in 20	50
1707	21,600	1078	1 20	50
1708	21,291	1687	1 12½	79
1709	21,800	1024	1 21	49
1710	24,620	3138	1 8	127
1711	19,833	915	1 21½	46
1712	21,198	1943	1 11	92
1713	21,057	1614	1 13	77
1714	26,569	2810	1 9½	106
1715	22,232	1057	1 21	47
1716	24,436	2427	1 10	100
1717	23,446	2211	1 10½	94
1718	26,523	1884	1 14	71
1719	28,347	3229	1 8¾	114
1720	25,454	1440	1 17½	56
Total	350,503	27,557	1 12.7	78

In this series it appears that the deaths from Small Pox are, to the total mortality, as 1 in 12.7; that is, 78 in 1000.

TABLE II.

Years.	Total Mortality.	Mortality from Small Pox.	Proportion.	Proportion to 1000.
1745	21,296	1206	1 in 17¾	56
1746	28,157	3236	1 8¾	115
1747	25,494	1380	1 18½	54
1748	23,869	1789	1 13½	75
1749	25,516	2625	1 9¾	103
1750	23,727	1229	1 19¼	52
1751	21,028	998	1 21	48
1752	20,485	3538	1 5¾	172
1753	19,276	774	1 25	40
1754	22,696	2359	1 9½	104
1755	21,917	1988	1 11	91
1756	20,872	1608	1 13	77
1757	21,313	3296	1 6½	155
1758	17,576	1273	1 13¾	73
1759	19,604	2596	1 7½	132
Total	332,826	29,895	1 11.2	89

In this series it appears that the proportion of deaths from Small Pox is, to the total mortality, as 1 in 11.2; that is, 89 in 1000.

TABLE III.

Years.	Total Mortality.	Mortality from Small Pox.	Proportion.	Proportion to 1000.
1784	20,454	1210	1 in 17	59
1785	18,919	1999	1 9½	106
1786	20,445	1210	1 17	59
1787	19,349	2418	1 8	125
1788	19,697	1101	1 17¾	56
1789	20,749	2077	1 10	100
1790	18,038	1617	1 11¼	89
1791	18,760	1747	1 10¾	93
1792	20,313	1568	1 13	77
1793	21,749	2382	1 9	11
1794	19,241	1913	1 10	99
1795	21,179	1040	1 20¼	49
1796	19,288	3548	1 54	18
1797	17,014	512	1 23½	30
1798	18,155	2237	1 8	123
Total	293,350	26,579	1 11	90.9

In this series it appears that the proportion of deaths from Small Pox to the total mortality is 1 in 11, that is, 90.9 in 1000.

TABLE IV.

Years.	Total Mortality.	Mortality from Small Pox.	Proportion.	Proportion to 1000.
1804	17,038	622	1 in 27½	36
1805	17,565	1685	1 10½	96
1806	18,334	1297	1 14	71
1807	17,938	1158	1 15½	65
1808	19,964	1169	1 17¼	58
1809	16,680	1163	1 14¼	70
1810	19,893	1198	1 16½	60
1811	17,043	751	1 22¾	44
1812	18,295	1287	1 14¼	70
1813	17,322	898	1 19¼	52
1814	19,783	638	1 31	32
1815	19,560	725	1 27	37
1216	20,316	653	1 31¼	32
1817	19,968	1051	1 19	53
1818	19,705	421	1 47	21
Total	279,404	14,716	1 18.9	53

In this series it appears that the proportion of deaths from Small Pox to the total mortality is 1 in 18.9, that is, 53 in 1000.

DISSERTATION XI.

Narrative of a Hurricane; with some Reflexions on the Effect of Commotion in the Atmosphere and in the Ocean on the Economy of Nature, and on Life and Health.

The condition of the atmosphere has, in all ages, been thought to exert an important influence on life and health. This opinion has been still more strengthened by those discoveries of modern science, by which the air we breathe, as well as water, the other great sustainer of life, has been chemically analysed, and its relation to animal nature satisfactorily ascertained. There is no department of natural knowledge in which the energy and success of modern philosophical research has shone more conspicuously than in the explanation that has been given of the constitution of these two elements, particularly in their relation to organic existence. This branch of science may be said to have been created in the course of the last half century, for it is in that time that the nature and relative proportions of oxygen, the great inciter of life, and, together with nitrogen, hydrogen, and carbon, comprising the main constituents, not only of air and water, but of all animal and vegetable substances. A new world, as it were, has been revealed to the votaries of general science as well as of the medical art; but as this branch of knowledge is now familiar to most persons of liberal education, these topics need not here be further enlarged upon.

But besides the chemical components of the rivers, the oceans, and the atmosphere, there is another aspect of these great features of the globe, of the highest importance in the general economy of nature, as well as to human life. I allude to those wise and wonderful contrivances by which these liquid and elastic fluids are kept in a state of constant motion. Had air and water been permitted to remain in a perpetual, or even long-continued state of stagnation, the whole system of nature, animated and inanimate, would have been deranged, and incapable of subsisting. The putrefactive corruption which would spontaneously take place in a state of rest, in both these elements, would have rendered them unfit for the support of life. The detrimental, nay, the poisonous and pestilential qualities acquired by stagnant air, have been repeatedly and forcibly adverted to in the course of these Dissertations.* The like remark applies to large masses of stagnant water. Even the Ocean, though provided with so large a portion of antiseptic matter, has been found, as I have been assured by experienced mariners, to become fetid in long-continued calms.

There are few subjects which afford a larger scope of meditation to those who have a taste for investigating final causes, than the present. Besides the action of wind, so well calculated to maintain the salutary condition of those enormous masses of liquid and gaseous bodies with which the terraqueous globe is surrounded, there are other circumstances in nature conducive to the same end. 1st. The surface of the earth has been so moulded and fashioned into inequalities and declivities, as to furnish channels for those perennial currents in the form of rivers, by which the water, supplied by springs and rain, is directed to those great reservoirs from which, by exhalation, the same sluices are again opened for maintaining that perpetual circulation of the aqueous fluid, by which the uniform order of nature is so beautifully and magnificently upheld.

Another important circumstance in the constitution of nature, tending to prevent the stagnation of water and air, is the difference of temperature, as affecting these two elements in their separate or mutual agency; as the rays of the sun in passing through diaphonous bodies, communicate little or no heat to them, unless where refraction is produced by their obliquity, or by the difference of density, or quality of the bodies through which they are transmitted. The main source of heat from the rays of the sun, is that which is produced by their impinging on opaque bodies on the surface of the earth. It follows from this, that as the air derives its temperature from its contact with the surface of the earth and ocean, it must, in general, be colder than these surfaces. It follows farther from these principles, and from those of hydrostaticks, that the water at the surface of a sea or lake, by constantly parting with its heat to the air, becomes of a greater specific gravity, sinks, and is replaced by what is warmer from beneath; and that conversely, the air having, from the acquisition of heat, become of a less specific gravity, ascends, and is replaced by what is colder from above. It is thus that while a perpetual salutary motion is kept up, the sea, the land, and the atmosphere are preserved in that equability of temperature which is favourable to life, preventing those extremes of heat and cold, which would have rendered every part of the globe uninhabitable.

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* See the effect of calms in promoting the plague, p. 131, and the noxious effects of want of ventilation, in Dissertations IV. and VII. passim.

But it is not in the mere circumstance of temperature that the beneficent provisions of nature are conspicuous: there is a peculiarity in the congelation of water, as distinguished from that of all other fluids, which, in this view, is eminently worthy of notice. It was observed by the Florentine Academy, as long ago as the middle of the seventeenth century, that when water, in the act of cooling, approaches close to the freezing point, it all at once expands to the same specific gravity which it had at seven degrees above that point, so that when congealed, it is of a smaller specific gravity than in its fluid state. This accounts for ice always forming at the upper surface of water, and not in its general mass: and it is well that Providence has so constituted this part of nature, for otherwise that whole portion of animated beings which inhabit the waters, could not have existed, or their life must have been extinguished. It may be observed, that a like benefit is rendered to vegetable life by snow, without the protection of which, by acting as a blanket, the northern regions of the earth would have been in a state of eternal hideous sterility.

There are further circumstances in the economy of the atmosphere, which exercise an important and conspicuous influence, by affecting the temperature, density, and motion of fluid bodies, and concur with temperature in forming the elements of meteorological phenomena. 1, That constantly encreasing tenuity of the air in the upper regionss of the atmosphere, whereby its capacity for heat being encreased, there is a constant diminution of sensible temperature as we ascend. The effect of this in condensing vapour, is greatly abated by that continued removal of atmospherical pressure, which so much favours evaporation. These operations go on in the atmosphere to a height which is unascertainable, but not indefinite, as has recently been most ingeniously demonstrated by Dr. Wollaston.* 2, Atmospheric air combined with aqueous vapour, is more rare, and therefore more buoyant than in its simple state. 3, It was first demonstrated forty years ago by Professor Volta of Pavia, one of the most genuine philosophers of this age, and whose name has been so eminently distinguished by subsequent discoveries, that water, in its state of vapour, possesses more electricity than in its fluid state, and therefore carries off a portion of it from those surfaces from which it is exhaled; and that this surcharge enables the air to hold more of it in solution. Electricity, in this respect, resembles the principle of heat, of which a portion is absorbed in a latent state, in the transition of bodies from a fluid to a gaseous state. It is plain how the unequal distribution of electricity, which thus arises, gives occasion to some of the most striking atmospherical phenomena, by that tendency which electrified bodies have to establish an equilibrium with neighbouring bodies differently impregnated, which they casually approach.

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* See Phil. Trans. for 1822.

It is further manifest how all these causes bring about, by their variously combined influences, whether in concurrence or counteraction, that salutary order of things which we behold, though apparently big with strife and confusion, and occasionally producing great partial calamity, as will appear in the course of this Dissertation.

It would be out of place here, and incompatible with the limits of this work, to indulge in any further illustration of the action and re-action of all these causes, in maintaining that order of nature, which is indispensable to the existence and welfare of animated beings, and in presenting to intelligent beings, that display of beneficence and harmony, of sublimity and beauty, which the more they are contemplated the more they transport the mind. We are indeed, after our most strenuous efforts, compelled to confess that the full comprehension of them, exceeds the utmost reach of ourfaculties.

I was occasionally led into such trains of thought, in passing through various climates in the course of my publick service, particularly by the occurrence of a Hurricane in the West Indies, in one of the years in which I was Physician to the Fleet on that station.

In the month of August, 1780, after the termination of a very active campaign, Sir George Rodney, the commander in chief by sea, sailed on a cruise with a fleet, consisting of ten ships of the line, and some smaller vessels, rather with a view to the health and discipline of the men, than for the purpose of any warlike operations. It happily occurred to him, that, as there is on that station, by a sort of tacit truce, a suspension of hostilities in the hurricane months, that is the three months of autumn, much might be gained by avoiding them, and by passing two or three months in a more salubrious climate. Instead of returning into port, therefore, he gave orders to steer for New York. On our return in November, we found that some of the islands had been laid waste by a hurricane in October, and that there had, from the same cause, been great losses at sea.

The first port at which the fleet touched was Carlisle Bay, in Barbadoes, the island which had suffered most by the hurricane. During our stay there, I informed myself of all the circumstances of this recent calamity, partly by my own observation, partly by enquiries of the most intelligent inhabitants, and employed my first leisure, after putting to sea, to reduce them to writing, in the form of a letter, to my highly respected friend, the late Dr. William Hunter of London, whose name will ever be illustrious as a teacher and improver of anatomy, as well as a man of high literary and scientific accomplishments.

Sandwich at sea, off St. Lucia, Dec. 22d,* 1780.

SIR,

Having returned to the West Indies with the fleet from North America, I found that, in our absence, there had been a most violent hurricane at Barbadoes, and some of the neighbouring islands, and I send you the best account of this interesting phenomenon I can collect from the testimony of those who suffered in it, and from the very visible traces of it now under my eye.

It began to blow hard at Barbadoes on the 9th of October; but it was not apprehended, till next day, that there would be any thing more than such a gale of wind as they experience from time to time in this island at that season. On the evening of the 10th, the wind arose to such a degree of violence, as clearly to amount to what is called a hurricane. At eight o'clock, p. m. it began to make impression on the houses by tearing off the roofs, and over-throwing some of the walls. As the inhabitants had never been accustomed to such a convulsion of nature, they remained till this time in security; but they now began to be in the utmost consternation, and the sufferings and calamities of the people, the ravage and devastation upon every object of nature and art, during the ensuing night, exceed all description. It was thought to be at the greatest height at midnight, and did not abate considerably till eight o'clock next morning. During all this time most of the inhabitants had deserted their houses to avoid being buried in the ruins, and every age, sex, and condition was exposed in the fields to the impetuous wind, incessant torrents of rain, and the terrors of thunder and lightning. Many were overtaken in the ruins, either by clinging too long to the buildings for shelter, in attempting to save what was valuable, or by unavoidable accidents from the fall of walls, roofs, and furniture, the materials of which were projected to great distances. Even the bodies of men and cattle were lifted from off the ground and carried for several yards. The cries of the helpless, wounded, and dying, could not be heard amidst the crash of ruins and the noise of the elements. At Bridgetown, the dead bodies were too numerous, and the weather too severe, to get them disengaged from the ruins for some days, and they emitted a putrid stench, which affected the air of the whole town. An estimate has been attempted of the number of deaths from returns made to the Governor, and they amounted to more than 3000, though several parishes had not given in their returns when I was there.

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* A ship of ninety guns, and the flag-ship of Admiral Rodney.

All the houses of the island have suffered more or less, and the damage has been the greater, that the buildings were not calculated to withstand such a shock; for there had been no such event on this island for a hundred and five years. The late hurricanes in our colonies have been confined to Antigua, St. Christopher's, and the other islands in their latitude, and those more to the southward began to flatter themselves with an exemption from such accidents. The large elegant church of Bridgetown is a heap of ruins, many of the private houses are levelled with the ground, all of them unroofed, and the whole of their carpenter work and furniture destroyed. The greater part of the inhabitants fasted for forty-eight hours, and they were obliged to dig from the ruins the necessaries of life, and clothes to cover themselves. This general wreck had a remarkable effect on the hearts of men. Any one that was more fortunate than his neighbour, prepared victuals to administer to the cravings of the first comer; the owners of warehouses gave what remained of their victuals and clothing almost gratuitously; and ideas of property and interest seemed to be forgotten in the moments of calamity.

All the fruits of the earth then standing have been destroyed, most of the trees on the island have been torn up by the roots, and (what will perhaps give as strong an idea of the force of the wind as any thing) many of them were stript of their bark. The sea rose so high as to destroy the fort, carrying the great guns many yards from the platform, and demolishing the houses near the beach. A ship was driven ashore against one of the buildings of the naval hospital, which by this shock, and the impetuosity of the wind and sea, was entirely destroyed and swept away. As many of the sick seamen were removed as was possible in these circumstances, but three-and-twenty of them were buried in the ruins. The mole-head was swept away, and ridges of coral rock were thrown up, which still remain above the surface of the water; but the harbour and road have, upon the whole, been improved, having been deepened in some places six feet, in others as many fathom, and the anchoring ground in the road is much better, the crust of coral which had been the growth of ages, having been torn up, leaving a soft oozy bottom. Many shells and fish were thrown ashore, which had been heretofore unknown

The sufferings and losses by sea have also been great and calamitous. The wind was too violent for any ship to ride it out, and they all pushed to sea, where most of them perished by the mere violence of the weather, without being driven anywhere on a shore. Out of twelve of His Majesty's ships of war that were exposed to it, eight have been totally lost, and out of the crews of them all, not more than ten or twelve persons have been saved.

It has been common to say that hurricanes are attended with earthquakes; but I used to consider it as a matter of vulgar fallacy and exaggeration, as might be natural enough in such a general agitation of nature. I have been at pains, from my own observation and enquiry of others, to ascertain this; and I think there can be little doubt that the earth, in such cases, does undergo a concussion different from what can arise from the mechanical impetus of the wind. I remarked that the flags in the floor of the great church at Bridgetown were set at angles to each other, though they were sheltered from the wind, and nothing had fallen upon them that could produce this effect; casks had changed their position in cellars below ground; masses of rock were moved, which the force of air and water did not seem capable of effecting; and there were chasms in the earth, which indicated clearly some internal agitation. The inhabitants of St. Lucia, as well as Barbadoes, told me they felt it plainly; and, considered as matter of testimony, it is confirmed by this, that at St. Lucia they informed me, that the earthquake happened several hours after the greatest severity of the gale; and people in different parts of the island, who never had conversed together, agreed in their accounts of the time in which it happened; they were people who had experience of earthquakes, and acquainted with the sensation they produce.*

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* I shall here mention some subsequent reflections on this subject, founded chiefly on the late improvements in chemical philosophy, particularly the very important discoveries of Sir Humphry Davy, which throw great light on the general system of nature, and accord

This hurricane has principally affected the middle Carribee Islands, and chiefly Barbadoes, which lies in latitude

with some of the theoretical ideas thrown out in this letter. Our globe may be conceived to have arrived at its present, state through the following series of events :—Let us suppose that two planets, or asteroids, to have been originally created, the one consisting of the metallic bases of the several species of matter now existing, the other of oxygene combined with azote and hydrogen, in the forms of water and atmospherick air. Let us farther suppose, that at some remote point of time in the abyss of antecedent eternity, these two bodies, in their movements through space, encountered each other. The consequence would be a mighty conflagration in the act of combination, as in common combustion; or like what may be conceived to take place in an aërolithe* on entering our atmosphere; for from the circumstance of these being always in an ignited state when they fall, it is evident that they are strangers there, and that they consist of metallic bases, which catch fire on the contact of oxygene. It is manifest, that all the bodies forming the exterior part of the earth, would, during this conflagration, assume the form they now have; but they would form such a crust as would prevent the contact of the oxygene with the more deep-seated materials, so that the combustion would cease before all the metallic bases were neutralized. This would leave the earth in the form of a sphere, surrounded with one immense ocean. But as the deep-seated metallic bases would be subject, from time to time, to the casual irruptions of water, the gas thereby generated would heave portions of the crust above the surface of the water, producing the dry land, and all its inequalities. Water would, from time to time, insinuate itself so as occasionally to reach these bases, and produce volcanoes and earthquakes, such as have occurred in the ordinary course of nature in past times, by the report of history, and from the observation of our own times, from the extrication of gases irresitibly expansive and explosive. And is it not possible, that under that sin-

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* Otherwise called meteoric stone, to which it is evident the presence of oxygene is new, and therefore could not have been generated in our atmosphere, but must either be a small portion of matter wandering through space, or a fragment launched by centrifugal violence or other accident, from asteroids circulating round the earth, too small to be visible. Should one of these, whether metallic or oxygenous, visit our ball, bodily instead of representatively in some future age, as I have alleged to have happened in some past age, it probably would not be very welcome, as it could hardly fail to induce some revolutionary changes in the present order of things.

13°, and has not experienced the like for more than a century; whereas the islands between latitude 17° and the tropic, are seldom exempt from them for more than seven

gular impetuosity of the torrents which takes place in a hurricane, the water may force its way by chasms and caverns to some of those metallic bases which had never before been brought into contact with water?

These may perhaps justly be deemed wild speculations, mere crude conjectures, but they are nevertheless in accordance with those principles of chemical philosophy, which have been developed by the discoveries of the present President of the Royal Society, and must constitute the main elements in any future and more sound theory of the earth, than that which has been sketched above: nor can they fail in time, from the range which they afford for diving into the depths, and soaring to the heights of our terraqueous globe and its atmosphere, to give birth to farther important discoveries and sublime meditations on the order and administration of the planet we inhabit.

The connexion of atmospherical with subterraneous commotion, has in no instance, that I know of, been more strikingly proved, than in an account published in the Journal de Physique of 1821, and in the Edinburgh Journal of Science for 1822, of the circumstances attending a hurricane and earthquake, which occurred simultaneously in the island of Zante, on the nights of the 29th and 30th of December, 1820. A luminous meteor appeared a few minutes before the first shock of the earthquake; then a tremendous storm of wind attended with thunder and lightning, loud, vivid, and long continued; torrents of rain, with hail-stones, weighing from six ounces to a pound and upwards. After the last shock of the earthquake another meteor appeared. The thermometer fell from 65° to 25°. We have no account of the barometer.—In this description it is mentioned that the hurricane was at its utmost pitch of violence in the night time on both occasions; and it is somewhat remarkable, that though in all other hurricanes, as well as common storms, which I have either observed, heard of, or read of, the like has happened, yet it has no where, that I know of, been the subject of remark, far less accounted for: nor do I feel myself prepared to discuss this question, but hope that this, as well as some other unsolved problems in the science of meteorology, particularly those relating to barometrical indications, will be undertaken by some one more competent to the task.

or eight years together. The islands that have suffered most on this occasion, besides Barbadoes, have been Martinique, St. Lucia, and St. Vincent's. They had it in a small degree at Antigua, St. Christopher, the Virgin Islands, and also at Grenada. At Tobago there was rough weather at the time, which did no material damage.

This is the extent of it north and south. It would be curious to ascertain how far it extended east and west, but of this we have only imperfect accounts. A ship that arrived at Barbadoes six days after, had a gale of wind about the time of the hurricane, which was remarkable only for this, that the wind blew all round the compass, a circumstance which distinguishes the hurricane from all other gales within the tropics; the course of nature being so far inverted, that the direction of the trade winds, at other times constant and invariable, is not then observed. It is true that at Barbadoes, the greater part of it was from the N. E.; but an hour or two after midnight it was for a little time due W. and was more or less in all the intermediate points. It was very irregular at different places in this respect, for at St. Lucia they had it not at any time from the west, but the ships that were driven from that island had it from all points. The progress of it westward was slower than might be expected, for at St. Vincent and St. Lucia, which are from eighteen to twenty leagues from Barbadoes, and to leeward of it, the hurricane was thirteen or fourteen hours later, and not near so violent. They had it at St. Domingo in a still less degree on the 13th and 14th of October. It was also remarked, that the ships which put before the wind were not carried with the velocity that might have been expected from its violence. Those who outlived the storm till the morning were surprised to find themselves so near the spot from whence they had been driven the preceding evening.

The influence of this general tumult of nature upon the health of man is none of the least curious of its effects. I have made much enquiry upon this head, not only at the medical Superintendants of the Naval and Military Hospitals, and the physicians of the place, but at private persons; and I find, that so far from its having been productive of sickness, there has been less of it since, and even that most of those who laboured under disease at the time benefited by it, except the very old and delicate, who suffered from mechanical violence, or the subsequent want of shelter. This is a fact so paradoxical, that if I had not a concurrence of testimony, and in some degree my own observation, I could neither credit, nor would venture to relate it. It had a visibly good effect on the diseases of the country; fevers, fluxes, and chronic diarrhæas the consequence of dysenteries, were also cured by it. But the diseases upon which it operated most visibly and sensibly were pulmonic complaints. Some cases, supposed to be beginning consumptions, and even the acute state of pleurisy, were cured by it. In the more advanced and incurable state, the hectic fever was in a great measure removed, and a temporary alleviation at least procured. A delicate lady, of my acquaintance, was ill of a pleurisy at the time, and passed more than ten hours in the open air, sitting generally in a plash of water, from the rain that fell; she had no more of her complaint, nor any return of it; and I saw her a few weeks after, in better looks and general health than she had enjoyed for a great while before. It was a general observation, that people had remarkably keen appetites for several days after, and a number of those whom I knew, formerly thin and sallow, looked fresh and plump a few weeks after, though the unhealthy rainy season was then hardly over.* I believe it will be difficult to account for this on any known principles, though we may advance some of those vague analogies and conjectures of which a great part of all medical reasoning consists. I should have observed before, that the air was excessively cold during the violence of the hurricane; and, as vicissitudes in point of cold and moisture are extremely productive of complaint in this climate, one would suppose *a fortiori* that this would have had a detrimental effect; but the animal economy is anomalous and full of enigmas. It is probable that the agitated state of the mind had some effect in averting the natural effects of the weather; just as a person when under exercise, or having his attention taken up on some interesting object, is less apt to suffer from exposure than if the body or mind were unoccupied. We can conceive too, that there may be something in it analogous to sea sickness, under which the body not only receives no impressions of disease, but the general health is sometimes mended. And may not some benefit, in the one case as well as the other, arise from the suspension of the functions of the stomach, and the other assimilating organs, which the body endures in both cases without the same detriment that it would, from a fast in what may be called cold blood? Neither is it ridiculous to suppose, that the purity and coolness of the air would have a happy effect on the animal frame, especially as the diseases of the lungs were most benefited by it. Dr. Priestley's doctrine of the exhalations of organic bodies in polluting the air, or of agitation in purifying it, is well known. I shall presently venture a conjecture, that almost the whole phenomena may have arisen from the act of establishing the balance of electricity, which in its passage from the air to the earth, or from the earth to the air, may be conceived to convey a salutary stimulus to the body.

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* It has been said before, that there is probably some connection between earthquakes and hurricanes, and it is mentioned in the Journal of the Royal Institution for 1817, that intermittent fevers were cured by an earthquake at the Carraccas, in March 1812.

I shall conclude this letter, already too long, by hazarding a few conjectures and reasonings concerning the nature and cause of Hurricanes. Some principles have been discovered by modern philosophy which go a certain way in explaining the economy of the atmosphere. First, In the first place, it is ascertained by experiment, that the rays of the sun are not essentially hot, but produce heat by their action on opaque bodies, or by repeated refraction in passing through pellucid bodies of different specific gravities. The temperature of the atmosphere, therefore, depends on the contact of the air with the earth and water of the globe, and is not affected by the passage of the sun beams (or very inconsiderably from the refraction caused by its different density at different heights), but its heat and cold are according to the aggregation and colour of the subjacent parts, and the obliquity of the rays. Secondly, It has been discovered that air, in a true and proper sense, unites with and dissolves water, forming with it a homogeneous elastic fluid, of less specific gravity than pure air. Thirdly, Evaporation of water is found to be in the compound proportion of the heat it undergoes, the dryness of the air in contact with it, the super-incumbent pressure it endures, and, it may be added, the electricity it contains; for the more water is impregnated with electricity, the more volatile it is, that is, the more miscible it is with water and the more convertible into vapour. Fourthly. All fluid bodies, when allowed to act upon each other in one mass, either rise, sink, or press laterally, according to their density or position. This difference of density in the air is commonly supposed to give occasion to all those motions in which wind consists.

The density of the air is affected by the height and pressure, by its heat or cold, by the quantity of water it holds in solution, and by the electricity it contains.

Constant and simple causes necessarily produce uniform and certain effects; complex and variable causes produce contingent and undeterminable effects. If the whole of the external globe had been either water or an even surface of earth, and if at the same time the axis of the globe had been at right angles to the ecliptic, thereby destroying the distinction of seasons, there would have been a constant or trade wind at all times in all places. But as things are, there are a number of causes which check and counteract each other, such as the difference of seasons, the diversity of sea and land, the different elevation and extent of land, and even the difference of vegetation and culture on its surface. In those places where the causes are most uniform we may expect the greatest uniformity of effect; and accordingly, where there is a great extent of the same continued surface, as in oceans, and at the same time a small difference in the obliquity of rays and the vicissitude of seasons, as between the tropics, there we find the wind to blow nearly the same way at all times. But, in consequence of this very uniformity, the causes of motion become more accumulated than in the variable regions where the hot and cold, the dense and rare, and the different impregnations of electricity in the several stages and tracts of the atmosphere, by being more frequently jumbled together, are from time to time brought to a balance and produce but moderate effects. The air in all regions of the earth is, we know, excessively cold at certain heights of the atmosphere, and the mountains of Peru are as cold as those of Lapland. In consequence of the long and uniform blowing of the trade winds, the cold air at top, as Dr. Franklin observes, comes to be poised upon rarer and warmer below, and there needs only some minute circumstance to destroy this equilibrium, and make the cold air rush down to the place it would naturally occupy by the laws of hydrostaticks. This circumstance is probably the recess of the sun; in consequence of which, in the month of August, the cold winds rush from the north-east (the quarter from which hurricanes begin, and gales and heavy rains generally come), and from the upper regions of the atmosphere, and the seasons in the West Indies continue rainy from thence till the winter solstice. From the slow progress of a hurricane, having been twelve hours travelling eighteen leagues from Barbadoes to St. Vincent's, from the local nature of its effects, from the winds blowing from different points at the same time in places near each other, from great degree of cold which could proceed only from the air of the upper regions, it would appear, I say, from all these circumstances, that the wind, on these occasions, blows rather in a vertical than a horizontal direction.

Many circumstances concur in shewing the very partial and local effects of land in agitating the atmosphere, and this is no where more remarkable than in the West Indies. The Island of Barbadoes, for instance, has suffered from droughts the last eighteen years, while in St. Vincent, a few leagues directly to leeward of it, there was no such complaint. Antigua is exactly to St. Christopher's what Barbadoes is to St. Vincent. There is always more rain on shore than at sea, on the mountains than on the plains, on woody ground than on what is cleared. Hurricanes, as we have seen, are also extremely partial, when the body of the atmosphere comes from the ocean, prepared for agitation and explosion from the varieties of its portions in point of density, temperature, and electricity; if it meets with a continent, the effect is divided and diffusive; but meeting with islands, particularly if they are mountainous, it discharges itself in a *focus*.*

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* Perhaps the great comparative infrequency of hurricanes at Barbadoes, none having happened there till now, since the year 1675, may be in part accounted for by its superior flatness in comparison of the other islands, which are all mountainous. Its geological structure is indeed strikingly different from the others, and accounts for its being less elevated. It is almost entirely composed of calcareous masses of shell, corallines, and madrepore, and without those vestiges of igneous eruptions observable in the other islands, in most of all of which there are craters or other traces of ancient volcanoes, some of which are still in action. The Caribbee Islands stretch in a sort of bow, from the southern point of North America to the mouth of the Orinoco in South America, and have evidently been raised by subterraneous fire operating in the whole of that line; and the sea is so shallow in the intervals of these islands, that the bottom can be seen from a ship. The island of Barbadoes lies about twenty leagues to windward of this line, where it would appear that the expansive force of the gas has acted with less force, so as merely to heave the immense strata of

The most northerly islands of the Caribbees are most subject to this concussion, probably from the vicinity of the cold

the above mentioned organic remains above the surface of the ocean, and there leave them without coming to a volcanic explosion.* The great *strata*, or cakes of calcareous matter, consisting of accumulated testaceous and zoophytick bodies generated at the bottom of the sea, bear manifest marks of this operation, for they are forced from their horizontal position in broken masses, forming in some places long caves, where they stand at angles to each other. Almost all the islands in Polynesia, and many in other parts of the globe, have had a similar origin. When this is taken into consideration, and also the prodigious quantities of the like organic remains, in marble, limestone, and chalk, a curious question arises, whether all this mass of matter, which bears a sensible proportion to the whole solid part of the globe, could have been formed by the organs of living animals, or from calcareous matter taken in by them in their food. It is so difficult to comprehend how and where these animals could meet with so much calcareous earth, that the supposition of its being elaborated by their organs, seems the most probable hypothesis. If this can be fully demonstrated, it will imply that some of the metallic bases, such as calcium, is not a simple substance, as has been thought, but resolvable into those principles which compose the aliment of animals. A celebrated and ingenious chemical philosopher, Mr. Hatchett, mentioned to me a fact, very much in favour of this. He remarked, that a chick, after the completion of incubation, possessed such a quantity of calcareous matter in its bones as could not easily be accounted for, but on the supposition of its being created in the course of the animal's growth from the materials of the yelk and albumen, all connexion with the shell being apparently cut off. This very nice question, which though belonging to minute objects, bears a most curious and important relation, not only to Chemistry and Physiology,† but to the formation and distribution of the materials which compose the globe of the earth.

Just as this note had been prepared for the press, Dr. Prout, so well known by his accurate and useful researches on Animal Chewinds of the temperate zone, which rush in upon the recess of the sun, and the tract of islands lying in a chain from east to west, between the 17° of latitude and the tropic, second each others effort, in attracting the electricity and oversetting the balance of the atmosphere. The effects of high land in condensing vapour, especially in the torrid zone, seems to depend on an electrical principle. In the cold and temperate regions, rain seems more owing to the mixture of cold and warm air, and more to the communication of electricity within the tropics, for there is more thunder and lightning here, and the common rain resembles that of the thunder-gusts of the north. I should have taken notice that the hurricane was attended with tremendous lightning. They told me at Barbadoes that it was in large steady blazes; and not much of the forked and darting kind. A physician who had been in the north of Europe, said, that in the north-east there was the Aurora Borealis, an appearance not natural to this climate. The French inhabitants of St. Lucia said there was a great deal of what they call the *Feu de St. Helme*, which I believe is the *ignis fatuus*; and an inhabitant of St. Vincent said, the lightning falling upon the earth, spread around like the sparks from an anvil. Electricity has a natural tendency to run off at points; and it is probably owing to this, that a shower, even at a distance, seems to descend in columns.

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* All human art and skill consist in the imitation of the operations of nature; and in no instance is this mimicry so conspicuously displayed as in the present instance; for is it not the same extrication and expansion of elastic fluids, that by their stupendous force, lift mountains and islands, nay, continents, from the bottom of the ocean, which the puny hand of man employs in his most boasted agencies? witness gunpowder, and the steam engine!

† See Elements of Medical Logick, page 58, 2d Edit. London, 1821.

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mistry, obligingly favoured me with a very elaborate and highly interesting tract on this subject, consisting of "Experiments on the changes which take place in the fixed principles of the egg during incubation," which will be found in the volume of the Philosophical Transactions, now in the press. This Gentleman, with that philosophical caution and reserve, which belongs to his character, does not give a decided opinion on the subject, alleging, that though there seems to be insuperable difficulties to the opinion of the lime in the bones being derived from the albumen, yolk, or shell of the egg, "he will not be bold enough to assert, in the present state of our knowledge, however strongly he may be inclined to believe it, that, within certain limits, this power is to be ranked among the capabilities of the vital energies"

In crossing the tropic, in our passage from North America, I was lucky enough to see a water spout, which advanced in the van of a shower and squall. It was a cylinder, with a defined and sharp outline, plainly directed downwards, for it descended in an angle to the sea, with the acute angle to windward. There was no mark of a whirlwind; nor was it a solid body of water, but an excessive heavy rain; and may be considered as the portion of a cloud, or body of vapour, which, by drooping lower than the rest, and being a little detached, had its electricity drawn off, so as to be condensed in a more violent and partial manner.

I shall now conclude this letter, as I am sensible, I am tiring you, though I have not exhausted the subject, and I am running into disquisitions more curious than useful. I am sorry I have met with nobody that made any observations on the barometer* or thermometer during the pheno-

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* A few months after this letter was written, I was informed by Dr. Warner, a very respectable physician of Antigua, that on occasion of a hurricane in that island some years before, he took refuge in a cellar, and having carried a barometer with him, he observed that the quicksilver fell to $27\frac{2}{18}$. This point of meteorology is farther illustrated by a singular crisis of the weather which occurred over the greater part of Europe, in the month of December 1821. The whole of that month was uncommonly tempestuous, but the incidents alluded to happened on the 24th and 25th days of it. These consisted in violent storms, such heavy rains as to cause calamitous inundations, thunder and lightning of unexampled intensity and duration; and a fall of the barometer below what is to be met with in the records of that instrument. In London and at Cambridge it fell to 28 inches, in the neighbourhood of London it fell it to 27.98, in Cheshire to 27.3, at Lyons to 25.9, at Augsburg to 25.6. The like accounts were received from other parts of Europe,† and every where attended with storms, long continued peals of thunder, and vivid lightning; igneous meteors were seen at Bamberg and Frankfort. At Vienne in Dauphiny it is described as if the whole heavens were on fire. It is farther remarkable that the winter was singularly mild all over Europe, so much

menon I have attempted to describe. I have never known the thermometer lower than 75°, nor higher than 85° at sea in this climate, and the range of variation in the barometer is much less than in Europe.

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† See more particulars of these phenomena in the London and Edinburgh Quarterly Journals of Science, and the Bibliothèque Universelle of Geneva for 1822.

I am, dear Sir,
with unfeigned esteem and regard,
your most obedient, and most humble servant,
(Signed) GILBERT BLANE.

P. S. It is a general traditional observation in the islands, that the hurricanes fall within two or three days of the new or full moon. This happened in the case I have related; but an ingenious member of the Royal Society[*] has lately shewn

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so in Russia, that great distress arose from the ground not being sufficiently hardened to bear sledges, the only means of conveyance in ordinary winters; nor was the cold sufficient to freeze their fresh animal food in the customary manner of preserving it in that season without salt. The only connexion of these atmospherical phenomena with subterraneous disturbance was, that a volcano broke out at this time, in a district of Iceland, where none had occurred since the year 1612, and an earthquake was felt at Mentz on the 25th. It is remarkable, that the barometer fell to[†] 28.08 in London, during the earthquakes of Calabria in 1783.—I shall conclude this digression with the mention of one other meteorological incident, which occurred in the West Indies since this letter was written. In the year 1812, there was an eruption of a volcano in St. Vincent; and it was found that an earthy dust had been ejected from it into the upper regions of the atmosphere, where it must have met with a current of westerly wind, for the Island of Barbadoes, twenty leagues to the eastward, was covered with it more than an inch thick, and it fell in large quantities on the decks of ships, more than a hundred miles to windward. It would appear, that the portion of the atmosphere which is carried to the westward, forming the trade winds, is returned in the contrary direction in an upper current; performing vertically to the atmosphere, what the gulf stream in those seas does to the ocean horizontally.

[*] See an article in the Phil. Trans. for the year 1766, by Dr. Horsley.

[†] See Phil. Trans. for this year.

by reasoning, clearly deduced from observation and calculation, that there is no foundation for the supposed influence of the moon upon the weather. This is satisfactory enough with regard to England and the variable climates, but I am inclined to think, from what I have observed, that within the tropics the moon does affect the weather, and it is what might be expected from the greater uniformity of the wind and weather.

To Dr. Hunter.

DISSERTATION XII.

On the Effect of Mechanical Compression of the Head, as a Preventive and Cure in certain Cases of Hydrocephalus. *

It was the Author's original intention to have included in this work a much larger extent of matter, but as the preceding Dissertations have run out to an unexpected length, —as some consideration is due to the time and patience of readers (though it has been his most anxious study to express what he has said in as few words as possible) in this age of unexampled and exuberant fertility of the press on all subjects,—under the uncertainty, also, of the publick being disposed to concede the same importance to productions as the partiality natural to authors ascribes to them, he is induced to withhold many minor tracts and observations which he finds in his notes, or dispersed in various collections, and will satisfy himself with recording one of the latest that has occurred in the course of his practice, as the last article of this volume.

In reflecting on the circumstances which characterize the history and description of hydrocephalus, some of the chief of which are, that it is very seldom met with but in very early life, and most commonly in infancy before the bregma is closed,—that there is in most cases a preternatural size of the head,—and that it is usually attended with a rachitic state of the bones and a general scrofulous flaccidity of the soft parts, and runs in particular families,—it occurred to me that the distention of the head and bregma is owing to a want of firmness and due resistance in the bony *compages* of the skull, which consequently yields to that effort of pressure with which the brain in its growth acts on its parietes. In reasoning further on the subject, it appeared to me conformable to some of the most approved principles of physiology, that, as there is a certain degree of tension and pressure necessary to the sound condition and action of parts,* the withdrawing of this, by inviting afflux and congestion, produces serous effusion; and that for the like reason, there may be a deficiency of that interstitial absorption upon which the healthy state of this and all other soft parts of the living frame depends.

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* This was originally published in a Periodical Journal, in 1821.

It was reflections of this kind, whether well or ill-founded, which some time ago suggested to me that mechanical compression of the head might be of use in the cure of hydrocephalus, and which induced me to make trial of it in a case which occurred to me last year, (1820). A child, aged thirteen months, had a head of a preternatural size almost from birth, and the bregma was preternaturally large. The conformation of the child was otherwise defective; for there was a visible curvature of the spine, indicating a rachitic diathesis. He had for several months been subject to drowsiness; and latterly it was evident, from his screaming, and from raising his hand to his head, that there were occasional paroxysms of head-ach. There had also been for some time past a dilatation of the pupils. The functions of the bowels were not so much disordered as is generally the case in this disease, which was still in an unformed state.

I directed the head to be swathed with a roller, as tight as could be done without producing pain or uneasiness. The only other remedies were three leeches, applied once only to the temples and forehead, and a purge every two days of rhubarb and sulphate of potash: mecury was not used in any form. An immediate amendment took place, and continued, so that all complaint was removed in less than three months, except the curvature of the spine ; and he has continued well till now, that is, for eighteen months.

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* See this subject further illustrated in Elements of Medical Logick, page 95, et seq.

The only other case which has since occurred in my practice has been one which did not offer so fair a field for the trial. The subject was a child of three years of age, with a head preternaturally large, and the bregma not yet closed. No symptoms of hydrocephalus had appeared, but only a state of general delicacy. The swathing has apparently been of benefit, and may probably prevent a disorder naturally to be expected from such a conformation.

Before sitting down to write this, thinking it likely that a view of the subject, seemingly so simple and obvious, might have occurred to others, and deeming it possible that similar trials might have been made, and the practice exploded from being found unsuccessful, I consulted all the works I could meet with, but without finding any intimation of the theory or treatment here described. I therefore felt it my duty, even at this early period of my experience, to suggest the trial of it to others. I have elsewhere remarked, (Medico-Chir. Trans.) that one of the great purposes of the general and early diffusion of the valuable information contained in periodical works, is to offer suggestions of this nature, in order that they may undergo either a speedy confirmation or refutation, the experience of one individual being too limited to afford that satisfactory induction which medical truth demands, or too protracted for the decision of questions which, for the good of mankind, ought to be as prompt as possible.

It is necessary to caution practitioners against a too-active use of this method in recent and acute cases, where there is inflammatory affection, and therefore such a degree of tenderness as may make compression painful and prejudicial. Let it be understood, that the practice here recommended is meant to apply chiefly to those cases in which there are indications threatening an attack of this disorder, such as a large head, a tardy closing of the bregma, dilated pupils and rachitic diathesis, or to those in which the acute stage has been vanquished by the usual remedies, and when there is a protracted or imperfect cure, or the apprehension of a fatal result from relapse. The times, circumstances, and degrees, in which this practice is admissible, must be left to the judgment of practitioners.

I would by no means rest the expediency of making further trials of this on the theoretical views which suggested it, but wish to refer entirely to experience. I am aware, indeed, that the theoretical views of others, being adverse to those which I have advanced, may produce a reluctance on the part of some practitioners to pay attention to what is here recommended. The cause of this disease has been referred by some to a depraved state of digestion, indicated by a distended abdomen and a vitiated state of the feculent matter, indicating a depraved action of the intestines, mesentery, and other chylopoietic viscera. But such disorders occur in innumerable instances without producing hydrocephalus; though it is easily conceivable how this state of bowels, which is so likely to arise in subjects predisposed to this disease, may excite or exasperate it, as well as all others of a rachitic or scrofulous nature, by producing depraved assimilation and scanty nutrition.

Other theorists are fond of representing hydrocephalus as proceeding, in most instances, from an inflammatory affection of the brain. There can be no doubt of such affection frequently taking place here; but I believe there are few instances of the acute state of hydrocephalus coming on without a predisposition consisting in an enlarged head and bregma: and it has been plausibly maintained by some, that a relaxed state of vessels, in particular parts, is the main cause of all inflammation. At all events, as it is found to run in families, this is a clear proof that it is a disease proceeding from a particular constitution, and not always depending on accidental causes. One of the cases here related, having manifest symptoms of predisposition, which were successfully combated, strongly proves and illustrates this, and affords a useful practical hint to parents and medical attendants. I knew a family of the highest rank and respectability, who lost the whole of their male offspring by this disease, and died some years ago without heirs of their own body to their titles and estates. Some of these children would probably have been saved, had the preventive measures here stated been then known.

But, leaving all theoretical disscussions out of the question, it is the Author's purpose merely to submit what he has said as a suggestion to others who may be induced to make trial of it, and report the result to the publick.

He has only further to suggest, that in case the utility of this practice should be confirmed by farther experience, it ought to be resorted to as a *preventive* as well as *curative* treatment, and applied whenever infants are perceived to have the head and bregma preternaturally large, without waiting its alarming manifestion by symptoms of hydrocephalus,—symptoms which, by this measure, may be happily averted.

Since the preceding article was written, several cases have occurred to some of my friends, as well as myself, strongly in favour of the practice here recommended; and two highly respectable and important testimonies of its value have been communicated by gentlemen, who are strangers to me, which I shall here give at length. One is from the late Dr. Girdlestone, an eminent practitioner of Great Yarmouth, in a letter to the Editor of the Medical and Physical Journal, enclosing the following statement from Mr. Costerton, an intelligent surgeon of the same place.

Mary Monks, a married woman, was delivered of a male child on the 3d of October, 1819. About a fortnight afterwards, the child became ill with sickness and fever, and a constant moaning and crying, without any very apparent dilatation of the pupils of the eye, but a considerable projection of the left parietal bone. The child visibly wasted; small doses of calomel were administered; but as no benefit was obtained by pursuing these means, and the parents were poor, the medicines were discontinued, and after wasting for two months the child died. There was no examination of the head, as I was not apprised of the child's death till after he was buried.

On the 9th of April, 1821, this woman was brought to bed of another boy, born apparently in good health. About three months after, his head became enlarged in the same manner as the child who had died. In the beginning of last October, the mother took him to Dr. Girdlestone; and he learning that the same appearance had been discovered in the other child before its death, and that I had delivered her of each of these children, deferred recommending any medical treatment, until he had some conversation with me. On Dr. Girdlestone seeing me, he detailed to me a paper he had just read in the London Medical Journal of October, from Sir Gilbert Blane, and gave it as his opinion, that this child was a proper subject for trying the treatment recommended by that physician. This child has the same symptoms of wasting, &c. as the other who died, and, superadded to them, a rupture on each side of the body. Dr. Girdlestone wished me to try first, without the aid of medicine, the simple effect of pressure on the brain; and as I could not succeed in confining a bandage round the parts, I put a double strop of adhesive plaister round the head, which completely answered the purpose. The straps remained firm as they were originally fixed. The child gradually improved under the pressure; and the head, which was originally bald, began to be covered with hair, and to acquire more uniformity; and as the muscular strength of the abdomen encreased, the ruptures disappeared. The teeth are cutting. the child is growing stronger, and may be said to be nearly well.

(Signed) CHARLES COSTERTON.

Yarmouth, January 29, 1822.

The other testimony is from Dr. Thackray, of Cambridge, whose learning and practical eminence, will have their due weight on the reader in appreciating his evidence. In a letter to the Author, dated Cambridge, the 10th of September, 1810, he says, "I am indebted to you for the idea of bandaging the heads of children, where that organ is larger than usual, and when the sutures do not seem ready to close in the usual time. In two instances I have seen great benefit from it. In one, where there seemed every proof of water being accumulated in the ventricles, the bandage seems to have effected a complete cure. The child, (thirteen months old) had never been able to sit up, and was easy only in the horizontal posture, was seized with fever, screamings, and most horrid squintings, and very spinage-like stools. Leeches often repeated, and calomel in large doses, reduced the fever, but the squinting and inability to sit up continued. I now tried a bandage of adhesive plaister around the head, and almost instantly the *strabismus* left the child, and she has gradually progressed to a firmness of muscles, can now sit in the nurse's arms, and can bear to be danced about. She still wears the bandage, which has now been on above six weeks. I conceive the child owes its life to this practice."

The substituting straps of plaster for bandages of cloth, I consider as a judicious improvement on my method. I have only to add, that this practice will, perhaps in the eyes of some, be more interesting from its being one of the few practical truths that have been discovered on suggestions derived by physiological theory.

THE END.

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ERRORS AND OMISSIONS.

Page 3, line 3 from the top, for *typhus,* read *typhous.*

Page 11, line 3 from the top, for *typhous,* read *typhus.*

Page 86, after the last word of the first paragraph, add— In the sixteenth century, the mortality incident to ships in those long voyages, which were first undertaken in that age, is hardly credible; and in the great contrast with modern times, we have a proof how much it is under the power of human management, and how much has been actually effected by it. Vieyra, a Portuguese historian of the early expeditions to India, says, " If the dead who had been thrown overboard between the coast of Guinea and the Cape of Good Hope, and between that Cape and Mozambique, could have monuments placed for them, each on the spot where he sunk, the whole way would appear one continued cemetery."

Page 92. Say at the end of the paragraph ending with the word *food*—Of all the means of prevention, there are none, perhaps, more effectual than shelter and warmth. A very strong proof of this occurred in the case of a company whose quarters were better than common, and who, when the others were employed in smoking their pipes, and conversing with their comrades in the open air, spent that time in a spacious kitchen with the Dutch family. Only one man in this company was taken ill, while the others were attacked in the proportion already mentioned.

Page 113, line 4 from the bottom, in the note, after Plymouth, say, " and Plymouth Dock."

Page 115. In the title of the Dissertation *dele* the three last lines.

Page 125, four lines from the bottom of the page, in the note, for 1162, say, 1262.

Page 143. The reference to the note should be from the word *list,* seven lines from the bottom.

Page 160. At the end of the paragraph ending with the word *ground,* add—I have it on the verbal information of Mr. Wiebel, Surgeon to the King of Prussia, that of all the allied nations whose armies invaded France in the severe winter of 1813-14, the Russians had the greatest number of sick.

Page 181, eight lines from the bottom, after the word *houses,* add, " with their concomitant moral effects, temperate and virtuous habits."

Page 208. After the paragraph ending with the word *water*, add, "There is reason to believe that ophthalmia is also communicated by dry dust; and it seems a rational precaution to damp the cloathing, floors, and furniture, in ophthalmic and plague hospitals."

Page 217. After the paragraph ending with *circumstances*, add, in a new sentence and the same line, "And it would appear that not only individuals, but whole communities, affected by latent and acquired predispositions, may either be attacked by a disease, or escape it, according as they may be exposed or not exposed to the occasional or exciting cause, as has already been remarked with regard to the plague.

Page 221. In a note by reference of the word *distrust*, in the third line of the second paragraph, say, "In looking over my notes on the Reports of the Navy Surgeons in their Journals, on the effect of the nitrous fumigation of which they were enjoined to make trial, I find that eleven ascribe some efficacy to it, and that nine deny any benefit from it; and as it does not appear that in any of these cases it was employed exclusively of other means of purification, there must be great ambiguity and uncertainty in appreciating its efficacy.

Page 255, six lines from the bottom, for *animal*, read *seminal*.

Page 332, two lines from the top, for *courses*, read *causes*.

KING'S

London: Printed by W. Nicol, Successor to W. Bulmer & Co.
Cleveland-row, St. James's.